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Thesis

AN EVALUATION OF THREE METHODS OF
TEACHING
NINTH-GRADE ALGEBRA

Submitted by

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In partial fulfillment of requirements for the degree of Master of Education
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CHAPTER I

INTRODUCTION

The Objectives of the Study

Effective teaching of any subject is dependent, at least in a measure upon the use of effective methods. It is a common belief that the benefits which pupils derive from any course depends in part on the ability and personality of the teacher, in part on the attitudes and abilities of the pupils, but to a larger extent on the teaching methods.

Algebra is recognized as a traditional subject in our secondary schools. It is probably because of this factor that so few of our teachers of the subject have evidenced real interest to explore some of the newer concepts of educational methods. It is true that occasionally one finds teachers experimenting with new methods but for most of its teachers algebra remains still a traditional subject to be taught in a traditional manner.

With this group in mind, this experiment was conducted. It was felt that if it could be shown that one or more of the methods used could produce greater gains, other factors being equal, such information would be most valuable. The benefit of such a finding, if applied, would be vitally felt in the accomplishment of the pupil, in the

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enrichment of the teaching technique, and in the efficiency of the school.

This study gives a limited amount of objective evidence concerning the outcomes of three different methods employed by the same teacher of ninth-grade algebra. These methods are later fully described and for the purpose of brevity are mentioned in the study as: (1) the recitation, (2) the supervised, (3) the unit method of teaching.

Within the necessary limitations of this study such differences in outcomes as appear may be attributed to the differences in the teaching method used, since groups of pupils whose achievements, under different methods of teaching, were compared and equated on the basis of probable ability to do the work of the course, and were taught by the same teacher using the same text book.

The study has been planned also to give some evidence on the relative advantages of the three types of teaching or methods employed for pupils in the equated groups who were in the upper level of ability and for those who were in the lower level of ability.

It was felt that such evidence might show that certain of the methods of teaching would be more valuable for one or the other of these two levels in ability. Such findings as might result would be much more valuable than mere subjective knowledge about the types of teaching.

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CHAPTER II

THE EXPERIMENTAL CONDITIONS OF THE STUDY

The Nature of the Problem

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Tiegs and Crawford in their book, "Statistics for Teachers", illustrate the rotation method as employed to determine the effect of comparing note taking and listening. The experiment shows the technique used generally under this kind of controlled study.

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Tiegs, Ernest W., <u>Tests and Measurements for Teachers</u>, pp. 204, Houghton-Mifflin Company, Boston, Massachusetts 1931.

^{2/} Tiegs, Ernest W., and Crawford, Claude C., Statistics for Teachers, pp. 142-144, Houghton-Mifflin Company, Boston, 1930.

Douglass, Harl R., The Experimental Comparison of the Relative Effectiveness of two Sequences in Supervised Study, University of Oregon Publication, Eugene, Oregon, 1927.

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Technique of Study. - Three methods of teaching ninth-grade algebra were devised and criteria set up, time limit arranged, and tests given before and at the close of each period. For clarification and designating purposes the three methods have been termed as: (1) the recitation, (2) the supervised, and (3) the unit method of teaching.

Methods used. - The recitation method embodied those teaching principles commonly referred to as traditional. The class period was used in giving the assignment, having board work, reciting, testing, and checking papers. No attempt was made to motivate, supervise, socialize, or employ any of the newer methods of teaching. It was as near to the traditional "lesson-hearing" method as it was possible for the teacher to conduct the class.

The supervised plan consisted of what many authorities have described as the "divided period" technique. In this plan the class period was divided in half for the purpose of recitation, testing, motivating, and supervising advanced work. Authority for this scheme is

Billett, Roy O., The Administration and Supervision of Homogeneous Grouping, pp. 44-60, Ohio State University Series, Number 4, 1932.

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called unit method of instruction. With the use of this technique, long-period assignment sheets or units had to be devised. These were based on the actual work of the text book since a departure from this scheme would have added an undesirable variable in measurement. The unit assignment sheets, as may be seen from an examination of one, 2/ consisted of a unit of work laid out on the basis of minimum and maximum requirements. It was advocated that the more versatile pupil work the maximum while the slower pupil might do the lesser number. "In each case the pupil pursued the teacher instead of the teacher pursuing the pupil, as is usual under the traditional plan." 3/

In was, therefore, the purpose of this study to measure, through achievement gains, the effectiveness of each of these methods. The results of which ought to establish better teaching, lessen wastage of valuable time, and prove an invaluable aid to those in whose charge rests the responsibilities of supervision of instruction.

Time Element. - Each of the mentioned techniques were in force for a period of ten weeks. Hence for the completed study a total of 30 weeks was necessary.

Douglass, Harl Roy, Modern High School Teaching, pp. 114, 2/ Houghton-Mifflin Company, Boston, Massachusetts, 1926.

See Appendix, pp. 17-18.

Shreve, Francis, Supervised Study Plan of Teaching, pp. 85-112, Johnson Publishing Co., New York, 1927.

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Time Blament. - Tock of the montioned techniques were in force for a period of ten weeks. Hence for the completed study a total of 50 weeks was necessary.

Outside of this period, the testing was accomplished. This required approximately four weeks time. Tests were given prior to the new work of the ten week period and at the close of that time. While each group was measured according to the three methods, it was not possible to teach each method at the same time hence the need for the rotation scheme.

The study began about three weeks after the opening of school and concluded at the close of school. The periods of class work were each forty-five minutes in length.

Construction of Comparable Experimental Groups

Matching pupils. - In order to arrive at satisfactory and stable deductions, the twenty pupils in each
group were equated according to their intelligence quotient, the results of an algebra prognostic test, and on
the basis of the average of their past four years marks
in arithmetic.

Chronological age of the pupils was not considered a major factor since in determining intelligence quotient such is employed but as a matter of fact the variation in age was a negligible factor.

It must be admitted that the average of the past four years arithmetic marks is an open issue as to relia-

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Eighty-one pupils, the total number of pupils, in the two classes used in this study, were given the "Terman Group Test of Mental Ability" and the "Orleans Algebra Prognosis Test". The average arithmetic marks for the past four years of all of these pupils were taken from the accumulative school record. Out of this total number, twenty cases were equated or matched as perfectly and as evenly as it was possible to do. The results of the individual standing on each test with the average arithmetic marks determined then the matching of one pupil with another in the opposite group.

Strictly speaking this was not absolutely possible in all cases as may be noted from the table following but where ever pupil was matched against another who had a lower intelligence quotient by a few points it was done with a case that had a higher prognostic result or arithmetic average or both. In each case a balance was attempted and approximately gained.

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attempted and approximately rained.

To illustrate the above procedure attention is called to the following cases.

Pupil number one in Group 1, who has an intelligent quotient of 131, an algebra prognosis standing of 172, and an average of 1 in his past four years' marks in arithmetic, is equated with pupil number one in Group 2 whose intelligence quotient is 143, algebra prognosis standing is 159, and average arithmetic marks of the past four years is 1. This case shows the matching in its poorest comparison. It will be noted that the intelligence quotients vary in difference by 13 points and that the prognosis standings vary by 13 points but this variation occurred in the intelligence quotient favoring one and in the prognosis test favoring the other. The average arithmetic marks were identical. It will be seen by the illustrative case how the writer attempted to balance such equated cases.

Against that case of poorer matching, examine case number 16 in Group 1 with case number 16 in Group 2. Here it will be seen the two cases in each of the three points used for equating are identical. Case number sixteen in Group 1 has an intelligence quotient of 102, a standing of 90 on the algebra prognosis test, and past arithmetic averages of a four year period of 2. The same case in Group 2 has exactly the same figures. Such

To illustrate the above procedure attention is called to the following cases.

Partil number one in Group 1, who has an intellistanding is 159, and everage atthmetic marks of the past four years is 1. I This onse shows the matching in its poorest comparison. It will be noted that the intelligence in the prognosis test favoring the other. The average such equated cases.

Against that case of poorer matching examine osse number 16 in Group 2 with case number 16 in Group 2. Here it will be seen the two cases in each of the three points used for equating are identical. Case number sixteen in Group 1 has an intelligence quotient of 102, a standing of 90 on the algebra prognosis test, and past arithmetic everages of a four year period of 2. The same case in Group 2 has exactly the same figures. Such

condition is ideal and represents the best of the matching. $\frac{1}{2}$

A more average case is illustrated in pupil number five of Group I as matched with pupil number five of Group II. Pupil number five in Group I has an intelligence quotient of 124, as against an intelligence quotient of 127 of pupil number five in Group II, an algebra prognosis standing of 156 as against one of 151 of pupil number five in Group II. Both pupils have an average of 1 for their past four years' marks in arithmetic. Such matching varies very little and is for the most part satisfactory for equating purposes. 2/

Out of the eighty-one pupils first considered for matching purposes, forty were chosen, twenty in each group. A larger number was preferred in this study but it was impossible to evenly equate, or to come near evenly equating additional cases.

A further explanation of the tests themselves follows under a discussion of tests later in this study.

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Table 1. - Standing of each pupil in the two equated groups according to intelligence quotients, algebra prognosis results, and the average of the past four years of arithmetic marks.

	Grot	ap I			Group I	I	
Pupil Number	Intelli- gence Quotient	nosis	Aver- age Arith- metic Marks2/	Pupil Number	Intelli- gence Quotient	nosis	Average Arith- metic ₂ / Marks
1	131	172	1	1	143	159	1
2	129	153	2	2	130	124	2
3	128	133	1	3	130	142	1
4	126	112	2	4	128	112	2
5.	124	156	1	5	127	151	1
6	120	151	1	6	117	166	1
7	120	159	3	7	122	159	3
8	117	90	2	8	120	98	2
9	114	155	2	9	115	148	1
10	113	133	2	10	113	151	3
11	109	131	1	11	108	152	2
12	106	132	1	12	102	137	1
13	104	166	2	13	103	122	1
14	104	74	2	14	103	74	2
15	103	128	2	15	105	128	2
16	102	90	2	16	102	90	2
17	103	66	2	17	97	78	2
18	100	122	2	18	100	119	1
19	102	87	1	19	100	85	2
20	101	59	3	20	100	59	3

For individual tables of intelligence quotients, algebra prognosis standings, and arithmetic averages see

2/ Appendix pp.

2/ 1 corresponds to A, 2 to B, 3 to C, and 4 to D or failure

adress betange out sit in the two agented groups coording to intelligence quotients, algebra prognesse religions of the average of the rest four years of arithmeticaries.

								321,50
			Orono II					
	Average Arith- metion Marks	Prog- nosis Algebra Test	-illeans genee thelious		Aver- age Arith- metic	Prog- nosia Algebra Test	Totelli- gence quotient	Il
	I	1.59		1	I	172	LSI	
		ASI	130			153	189	
	1	SAI		3	I	133	128	
1	S	112	128			112	126	
	I	161	131			1.56	124	
	1	1.66	1177		1	161		
	3	SET	122	7		159	120	
	8		0.20				ATT	
	I	148				155	114	
	2:		113	OI		135	II3	
			108		1	131	109	
	I	737			I	132	106	
	1	SSI	101	13		166		
	S	74	102	14	S	27	104	
		138	1.05	2.5		123	103	
	S		102	16			301	
				17			103	
	I	ett	100	18		122	100	
	S		100	1.9	Ţ		102	
			100	0.0			101	

Securing Comparable Experimental Conditions

<u>Variables</u>. - Having matched the pupils, an effort was made to control other variables which might unduly influence the result.

In a study of this nature no concern occupies greater attention of the experimenter than this question of variables. It is necessary to isolate the variable whenever possible. As Douglass points out, "Those factors or influences likely to affect the experimental results must be either eliminated, kept constant, or subjected to measurement and allowed for". 1/

It must be admitted that there are factors that are impossible to control. This is probably true of every experiment dealing with the human element. Illustrative of an uncontrolled factor is the question of individual industry. There are others which will occur to the mind of the reader but so far as it was possible all variable factors were eradicated. A brief discussion of some follows.

Teacher variable eliminated. - At first in thinking out the procedure of the experiment, it was planned to
use three different nin-th-grade algebra classes taught by
two different teachers. This idea of course introduced a
teacher variable. It can be easily understood that these
teachers in their ability and understanding of methods might

Douglass, Harl Roy, The Experimental Comparison of the

Relative Effectiveness of Two Sequences in Supervised

Study, University of Oregon Publication, Eugene, Oregon, pp. 177.

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Tescher veriable eliminated. - At first in thicker out the procedure of the experiment, it was planned to three different nin-th-grade algebra classes taught by different tenchers. This idea ofcomes introduced a chor veriable. It can be easily understood that these chera in their ability and understanding of methods might

be better adapted to use one of the three procedures to a greater advantage than the other - not an unreasonable assumption at all. Hence such an idea was abandoned and in its place the idea of two classes taught by one teacher was substituted.

The question of pupil variability has already been discussed. 1

Test variables. - Realizing the benefits of standardized tests and their reliability but at the same time knowing that they fail to measure sections of subject matter fully, that is - fail to measure, at times, materials taught over short periods of work, it was decided to use in addition informal objective tests devised by the experimenter which would very definitely measure each ten-week period of work. It is the feeling of the writer that these tests measured more satisfactorily the periods of work with less variability than did the standardized tests. This opinion is borneout by Dr. Billett's study in homogeneous and heterogeneous grouping where he used both standardized and objective tests. "Objective tests proved slightly more desirable than the standardized tests as measure of results".

In making out these objective tests, it was not always possible to forecast the exact chapter at which the work would close for that period but in each group the manual accompanying the text, Betz' "Algebra for Today",

^{2/} Billett, Roy O., The Administration and Supervision of Homogeneous Grouping, pp. 107, Ohio State University Series, Number 4, 1932,

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"ye possible to forecast the exact chapter at which the

"k would close for that period but in each group the

nuel accompanying the text, Betz' "Algebra for Today",

was used to excellent advantage. In this manual the author listed lessons and topics that he had found from years of experience to be about the correct proportion for assignment for the average classes. These aided greatly in forecasting the assignments for the advanced ten week periods and served admirably in building unit-assignment sheets and objective tests.

In no case did the classes get beyond the material covered in the objective tests and in a few instances failed to cover the whole of the material but since this was true of both groups the relative measure was constant.

Variation in amount of subject matter covered by
the two groups. - In this study one group did not advance
more rapidly than the other in the matter of covering materials. Both groups were kept carefully to approximately
the same section of the text. This eliminated all possibility
of one group starting with a greater gain in achievement
than the other. All material used in building the objective
tests, units of assignment, and daily work came from the
text book. The exception to this would be only in materials
used in class discussion by the instructor and in this no
difference was evidenced.

It has been argued by some that since the materials covered by each group and under different methods were not the same that here rested a variable. To clarify the point

Betz, William, Algebra for Today, First Course, Teachers Manual, Ginn and Company, Boston, Massachusetts, 1929.

the same to except advantage. I in this manual the most listed lessons and torics that he had found from yours experience to be about the norrest proportion for hesien. It for the average classes. These sided greatly in fore-ting the satignments for the advanced ten week pariods that the satignments for the advanced ten meet pariods estive tests.

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an examination of the plan as carried out is shown:

Table 2. - Teaching procedures shown in rotation during the experiment

Groups	First Ten-Week Period	Second Ten-Week Period	k Third Ten-Week Period	
	Method Used	Method Used	Method Used	
I	Recitaion	Unit	Supervised	
II	Supervised	Recitation	Unit	

It is true that the materials differed somewhat, as ofcourse they must, as the class advanced but the relative distribution of oral work, numerical work, and written problem work was quite equal under all three periods of the experiment.

Actually there are three experiments being conducted, one for each ten-week period.

During the first ten-week period, we are measuring the relative merits of the recitation and supervised procedures with two equated groups. The statistics are computed on this basis in mean gains in terms of standard deviations. Then the second ten-week period in the equated groups, we are endeavoring through the study to determine the relative values of the unit and recitation methods. Again computations are made and results recorded. During the third ten-week period, the supervised method is measured in comparison to

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Third Ten-West	Second Ten-Week	First Ten-Veck	BOX
Supervised	thit	Recitation	
timi	Reditation	Supervised	

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the unit method with the equated groups. The statistical treatment follows as in the preceding cases. Thus in each period we have an experimental unit in itself and each method is measured in comparison to the other method. Considering the study in this light, the variable of differing materials of subject matter is minor.

Further-more since the gain of each group for each ten-week period was reduced to a mean gain in terms of standard deviations, they are comparable.

A table following later in the study shows the data on each unit of experimentation.

Many similar rotation technique studies have been conducted successfully. 1/

Text book variable. - To overcome possible variability caused by different text books both classes were supplied at the beginning of the year with the same text, "Algebra for Today" by William Betz. 2/

Teaching method variable. - As to overlapping of teaching methods from one plan to another, all that can be said is that the writer and the instructor endeavored to maintain each method as far as possible in each allotted period for experimentation. The instructor was heartily interested in the study and his care and cooperation made possible as accurate a study as could be made under our conditions for experimentation. All members of the staff from

^{1/} Tiegs, Ernest W., <u>Tests and Measurements for Teachers</u>, pp. 207-208, Houghton-Mifflin Company, Boston, 1931. 2/ Betz, William, op. cit.

unit method with the equated groups. The statistical toom to the preceding cases. Thus in each mead we have an experimental unit in itself and each meais measured in comparison to the other method. Consider the study in this light, the variable of differing rials of subject matter is minor.

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ions for experimentation. All members of the staff from

the supervisory official to the writer did every thing that could be done to make for reliability and accuracy. A further consideration of methods as employed for each plan and group will be found in a later discussion.

Chief this plan of teaching, the instructor audenvoice to

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of teaching algebra. It was included in nativation, caper-

Criteria for the supervised plan. - To the super-

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CHAPTER III

A DISCUSSION OF THE THREE METHODS USED IN THE EXPERIMENT

Setting up the Criteria for each Method

Criteria established for the recitation plan. Under this plan of teaching, the instructor endeavored to
maintain the traditional recitation scheme of conducting
his class. The advance assignment was given at the beginning of the class period, papers of the previous assignment
collected, questions asked of pupils, recitation, drill, and
board work followed. Tests were frequently used. Little or
no individual help was given other than through board work
or recitation. The period was to all purposes and indications a recitation conducted under the traditional method
of teaching algebra. It was lacking in motivation, supervision, socialization, and individual help.

Criteria for the supervised plan. - In the supervised plan or the divided period, the methods used consisted of a period divided in half, that is twenty-two minutes the first part of the period were devoted to the assignment and the day's work while the remaining twenty-two minutes were used for supervised study of the advanced assignment. It was an arbitrary division of time and was rather
strictly adhered to in this study.

CHAPTER ILL

A DISCUSSION OF THE THIRD LETTERS

Setting up the Criteria for each Method

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It must be conceded that for the divided period

plan of supervised study our periods were too short in

time but this was entirely unavoidable since a change

here would have necessitated a wholly new program for the
school. It was felt that even with this defect the trend

of relative gains, since all periods for all of the plans

were the same, would be a fair consideration.

The principal points of interest to the reader of the first twenty-two minutes of the period are:

- 1. Motivation of assignment
- 2. Clarification of difficulties
- 3. Informal discussion of day's work
- 4. Recitation
- 5. Testing
- 6. Checking papers

The second half of the period was devoted to the supervision of the advanced assignment. This supervision consisted of the rendering of:

- 1. Individual aid
- 2. Observing work
- 3. Correcting errors
- 4. Testing
- 5. Explaining
- 6. Fostering group work
- 7. Aiding in developing better study habits

^{1/} Kilzer, Louis R., Supervised Study, pp. 107-108, Professional and Technical Press, New York, 1931.

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In fact, Douglass describes supervised study in its broadest sense as including "the whole of the teacher's activities, assignments, explanations, discussions, testing and all". 1/ Kilzer states that it should be used "whenever the pupil needs encouragement, wise guidance, and assistance in his learning activities". 2/

Criteria established for the unit plan. - In attempting to get a thorough understanding of the unit plan in teaching it was necessary to survey the literature in this phase of educational work and later to establish, as best served our needs, the phases of the knowledge obtained for the criteria of the unit plan.

Surveying the material written on the unit method of teaching. - There is no better source of material for the designated purpose than that found in a national survey conducted by Dr. Billett entitled "Provisions for Individual Differences, Marking and Promotion". 3/

To comprehend the unit plan as conceived by many educators involves an understanding of some of the plans from which certain aspects of the unit procedure have been derived. These plans have been commonly referred to as (1) Morrison's plan, (2) the Dalton plan, (3) the Winnetka plan, (4) the contract method, (5) the project method,

^{1/} Douglass, Harl Roy, Modern Methods in High School Teaching, pp. 106, Houghton-Mifflin Company, Boston, 1926.

^{2/} Kilzer, Louis R., op. cit., pp. 3.
3/ Billett, Roy O., Provisions for Individual Differences,
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Douglass, Harl Roy, Modern Methods in Might Gehool

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(6) differentiated assignments, and various modifications of one or another of these.

Morrison in his plan advocated that the subject matter be allocated into certain types such as "the appreciation type, the science type, the language type, and the pure practice type." 1/ In teaching procedure, he advocated these five steps: (1) exploration, (2) presentation, (3) assimulation, (4) organization, (5) recitation. The exploration period was used in ascertaining the knowledge of pupils prior to their being taught. The presentation period was used in giving a preview of the unit "through direct, convincing oral presentation". 2/ This step is followed by the assimulation period where the class is organized into a study room. The better students may do supplementary work, make oral reports, or contribute in general to the group. Following this period comes the organization period where the material is organized into "a coherent and logical argument and not merely an exhibition of facts". 3/ Those who have mastered the unit during the recitation period present it to the group.

The whole plan calls for the setting up of guide sheets carrying references, supplementary work, and aids to the making of tests.

Differentiated assignments are used extensively.

"The typical procedure in differentiating assignments is
to give the slower pupils quantitatively less to do and

^{1/} Billett, Roy O., op. cit., pp. 240-241.

^{2/} Ibid., pp. 240-241.

^{3/} Ibid., pp. 240-241.

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but the slower pupils quantitatively less to do and

to give them work which is quantitatively less difficult in that it requires less intelligence. The process is reversed for the brighter pupils". $\frac{1}{2}$

The Dalton plan needs consideration in the background material for unit construction. This plan embodies four major steps: (1) the classroom became a laboratory or work shop, (2) the pupil was allowed freedom to work out his contract either by himself or in a group, (3) assignments were made in the forms of contracts and challenges with minimum, average, and maximum, (4) the teacher is present in the room to maintain favorable conditions of study, to enlarge upon the assignment, to stimulate, direct and supervise the work. "In each case the pupil pursues the teacher instead of the teacher pursuing the pupil, as is usual under the traditional plan". 2/

Of more definite concern in forming of the unit plan is the so called Winnetka plan. This plan has been fostered by Burk and Washburne. Its keynote is individualized instruction. It embodies prognostic and diagnostic testing. Work is laid out in units and as rapidly as a unit is covered, the mastery test is given. The pupil's work is given to him in the form of the "assignment booklet". This booklet contains: (1) a statement to the child of what he is to try to get from the text, (2) essential materials not given in the text, (3) separate sets of exercises for each objective, (4) sets of answers of all

^{1/} Billett, Roy O., op. cit., pp. 241-261 .

^{2/} Shreve, Francis, Supervised Study Plan of Teaching, pp. 86-87, Johnson Publishing Company, New York.

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Billett, Roy O., or, cit., pp. 261-261 .

exercises for self correction.

In its larger phases the plan embodies socialized, self-expressive, and creative procedures. Correlation of subject work is evident, homogeneous grouping on the basis of social age is found, and each child is dealt with in an individual manner.

These plans are the major ones that have supplied the background for the unit method in teaching. They have been summarized briefly for the purpose of acquainting the author with the literature of the field and also the reader if need be. Having covered the literature, the experimenter next endeavored, in the light of his survey, to set up principles for the unit construction for the study.

Building the units. - In constructing the units, it was necessary to depart from the better plan of selecting with great care materials, references, and supplementary work from here and there and for the sake of reliability in measurement follow the text chapter by chapter. It is granted that such is not conducive to building superior units but since each of our groups and plans had to be kept together and cover like material there was no other alternative.

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The fundamental parts of our units as used in this study are: (1) directions for study, (2) references, (3) supplementary work, (4) outline of minimum and maximum essentials, (5) tentative time schedule.

As to the time allotment no hard and fast rule was followed but a tentative schedule was set up for the purpose of guiding the pupil in his allowance of needed time. In most cases the pupil covered an assignment each period or day. In most cases little or no stimulation was essential. Students plunged forward with splendid zeal.

The teaching steps under unit procedure condisted of: (1) introduction of unit, (2) individual work periods, (3) periods of class discussion, (4) testing period.

The introductory step served primarily to give the pupil a preview of the unit and to arouse his interest. It also served as an opportunity to diagnose individual needs and to determine the pupils knowledge about the unit.

As to the methods that were employed in the introductory step this list notes them: (1) class discussion,

(2) purpose and content of the unit clearly indicated by
the instructor, (3) preview of the unit-assignment sheet,

(4) assignment, (5) oral questioning.

In most cases one period rendered time enough for this part of the work. Later individuals needed points clarified but this was accomplished by calling the group together for a few moments at the beginning of the period The fundamental parts of our units as used in a study are: (1) directions for study, (2) references, supplementary work, (4) outline of minimum and maximum supplementals, (5) tentative time schedule.

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or helping individuals.

The chief function of the work period lay in solving and completing the assigned unit. Methods used during individual work period: (1) questions raised by individuals were answered by the teacher, (2) teacher carefully observed pupils at work and pointed out errors to individuals, and at times to the whole group as the need demanded, (3) classroom became a work room, (4) teacher aided in improving study habits, (5) discussions were directed by the teacher at times, (6) pupils worked individually for the most part but were assisted by other pupils at times, (Little group work was done.)(7) teacher gave brief objective tests, (3) assignment sheets were checked by instructor and weakness noted to be clarified later with goups or individuals.

The time required for this period depended entirely upon the length, difficulty, and type of unit work to be accomplished. A general time was set by the instructor but was changed or modified as need arose. Such happened occasionally.

In the period for class discussion, the attempt was made to clear up all difficulties, review the entire unit of work, give any needed drill work, have the pupil participate in oral discussion and boardwork. The time devoted to this period was again a matter of judgment upon the part of the instructor. It depended upon the nature of

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the material being covered and the mastery of that material by the pupil.

The major significance of the objective tests was to determine how well each pupil had mastered the material in the unit. Occasionally these tests indicated the need for additional drill material or clarification of uncertain phases of the work. Such was promptly supplied.

In evaluating the unit assignment and its varied procedure, it must be admitted that it so far meets the need of supplying work for individual needs far superior to any other technique. It is the basis of remedial work for slow pupils and through its differentiated content renders ample material for the more versatile pupil.

The unit assignments, as used in this study, follow in the appendix of this paper. It will be noted that many of the directions and aids for solutions are to be found in the text book, "Algebra for Today" by Betz. 2/

Further comments on these three plans, the recitation, the supervision, and the unit method occur along with the deductions and conclusions of the study itself.

^{1/} See Appendix, pp. 67-68. 2/ Betz, William, op. cit.

Lairoten feing covered and the mastery of that material

The major eignificance of the objective tests to determine how well each pupil had mastered the material in the unit. Occasionally these tests indicated the design of the additional drill material or clarification of unitsin phases of the work. Such was recordly supplied.

In evaluating the unit assimpent and its variation of the tit as far meets that of supplying work for individual needs far superior any other technique. It is the basis of remedial work alow pupils and through its differentiated content there ample material for the more versatile pupil.

The unit assignments, as used in this study, low in the appendix of this paper. I It will be noted to many of the directions and mids for solutions are to found in the text book, "Algebra for Today" by Zets. Z

Purther comments on these three plans, the retation, the supervision, and the unit method occur along the the deductions and conclusions of the study itself.

CHAPTER IV

A DESCRIPTION OF THE TESTS USED IN THE EXPERIMENT

Standardized Tests Used in this Study

The Orleans Algebra Prognosis Test. - The first test to be given was that of the Orleans Algebra Prognosis The test was made for the purpose of predicting a pupil's algebra success and was used in our study for that purpose in attempting to match pupils for the two experimental groups. The test is constructed in twelve parts, each part excepting the first and last have a lesson preceding the test. The pupil studies the lesson and then solves the test. The parts of the test are: (A) arithmetic, (1) substitution in monomials, (2) use of exponents, (3) measuring of exponents, (4) substitution in monomials with exponents, (5) substitution in binomials with exponents, (6) like and unlike terms, (7) representation of relations, (8) representation of expressions, (9) positive and negative numbers, (10) problems, (11) additional of like terms, (12) summary test. 2/

In experimenting with the test in two different schools, the authors found the coefficient of correlation between the prognosis test and achievement test to be .82 in one school and .71 in the other. Since, additional material has been added. It is considered that a correlation of .80 is high enough for the purpose of the test.

Orleans, Joseph B. and Orleans, Jacob S., Orleans
Algebra Prognosis Test, World Book Company, New York,
1928. See samples in Appendix.
2/ Ibid.

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A DESCRIPTION OF THE TESTS USED IN THE

The direct entering Algebra Prognosis Pest. - The first of the be be given we that of the Dileans Algebra Prognosis of. I the payeness of predicting the first sagebra exposes and was used in our study for st purpose in estempting to match pupils for the two perimental groups. The test is constructed in twelve ria, each part excepting the first and lust have a lesson esting the test. The papil studies the lasson and then lyon the test. The papil studies the lasson and then senting of exponents. (1) use of exponents. (2) embatitution in monomials, (1) use of exponents with exponents.

) like and unlike terms, (7) representation of relations.

1) representation of expressions, (9) resitive and negative muchans, (10) problems, (11) additional of like terms.

2) summary test. 2/

In experimenting with the test in two different noiselection the suthers found the coefficient of correlation stween the prognosis test and mobileyeant test to be .92 and one noted and .71 in the other. Since additional married has been added, It is considered that a correlation for the purpose of the test.

Using the prognosis test. - In this study the prognosis test was given in October after the pupils had had nearly six weeks of algebra. Hence the scores were higher than they would have been had they been given at the beginning of the school year or at the end of the eighth grade but for the purpose of using the results to pair pupils this factor made no particular difference since the individual scores would be relative and since the test was given to both groups on the same date. The scores made in this test by the selected pupils may be seen in Table I on page 10.

The Intelligence Quotient Tests. - The Terman Group Test of Mental Ability was given to find the intelligence quotient. If This was used in two forms, A and B. Each form contained 185 items. The pupil was given the highest score made in either test. By giving both tests the margin or error was reduced. The forms were given about ten days from each other. Each form consumes about an ordinary school period. Educational authorities consider Terman's test to be one of the better intelligence tests on the market. For the intelligence quotients obtained in this investigation as they were used to match pupils, see Table 1 on page 10.

Columbia Research Bureau Algebra Test. - To measure the achievement or gains of pupils in the study

^{1/} Terman, Lewis M., Group Test of Mental Ability, Grades 7-12, World Book Company, New York, 1920

Mains the oragnosis test. - In this study the smarts test sur given in October after the pupils had nearly six seeks of algebra. Hence the scores were her than they would have been had they been given at beginning of the school year or at the end of the oth grade but for the purpose of using the results to rupils this factor made no particular difference ce the individual scores winds be relative and since test was given to both groups on the same date. The test was given to both groups on the same date. The

The Intelligence Sactiont Seets. - The German

on Test of Mental ability was given to find the inligence quotient. I this was used in two forus, A

3. Sach form contained 135 items. The puril was given
highest score used in either test, sy giving both tests
watein or error was reduced. The forus were given about
days from each other. Asch form consumes about an orary school period. Discational sutherities consider
the market. For the intelligence quotients obtained
the market. For the intelligence quotients obtained
this investigation as they were used to match pupile.

Columbia Research Bureau Almebra Feet. - To

the Columbia Research Bureau Algebra Test was used. The test consists of a series of two forms each. Form 1A-1B is for use during the first half of the school year while Forms 2A-2B are to be used in the last part of the school year. Achievement could be measured by using either form alone as, Form 1A for the first part of the year and Form 2A for the second part, but in order to get a more accurate measure both forms were used in this experiment and the sum of the results recorded. Test 1A-1B contained two parts, one part had thirty-six examples typically of the mechanical kind, the second part had twelve problems which needed a knowledge of equation for solution. In test 2A-2B there were two parts, the first part consisted of twenty equations to be solved and the second part had twenty-five problems involving the use of various equations.

The reliability of the test. - The authors found the coefficient of reliability of the entire test lA-lB to be .94 for one group of l15 students and .39 for another group of l47 students. The score on the test correlated with the teachers' marks to the extent of .68 and .72 for the same two groups. On Forms 2A-2B the reliability found by correlating the odd numbered items with the even numbered ones on two hundred cases was .847 for the whole test. This score when computed into reliability coefficients of correlations by the Spearman-Brown formula was .917.

Orleans, JosephB., Orleans, Jacob S., Wood, Ben, Columbia Research Bureau Algebra Test, World Book Company, New York, 1929

golumbia deservon bureau Algebra Test & van unti-AL-AL MINE . does somet out to series a to stringoo test Loodon add to frag fant add at heen ad of are ES-AS a r. Achievement could be measured by uning cities form made one that the first part of the year and lorm the results recorded, Test la-1B contained two perts, Instruction will be villaging as a server win-viriet bad ther chedge of counties for solution. In test SA-83 there s two parts, the first part consisted of twenty equaavil-ginews bad tree Ancess and has beries ed of an lens involving the use of various equations,

The reliability of the entire test LA-LD outficient of the entire test LA-LD outficient of the entire test LA-LD outficient of the entire test care for unother to test for unother and at lar, etudents. The spore on the test correlated to the testhers! marks to the extent of .63 and .72 for some two groups. On forms 2A-SE the reliability found correlating the odd anabered sees was .947 for the whole

t. This score when computed into reliability coeffi-

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Tests 1A-1B take forty-five minutes each while tests 2A-2B take fifty minutes each. It will be seen that much time was consumed in testing.

Objective Tests Used

Objective tests A, B, C. - Three objective tests were made by the writer covering strictly the material included in the ten-week period of experimentation as best as could be determined. These tests contained various forms of the new type tests such as, true-false, best answer, problems and solutions. - Each item came from the basal text used in the study and the answers from the accompanying answer book. In scoring these tests all questions, except problems, counted as a point. Problems, since their difficulty was considered to be twice that of other items, scored two. The total scores of each test varied a little but largely they remained much the same in difficulty. A forty-five minute class period was used as the testing time for each objective test. It is assumed by the writer that these objective tests measured the pupil gain better than did the standardized tests since they bore more directly upon the tested material.

Many standardized tests, expecially is used over short periods of testing, actually measure very few items taught. This is ofcourse in direct variance with objective tests especially constructed for those periods.

^{1/} See Appendix for samples.

slide done setunin evil-yinol stat El-Al steet that a EA-EE take fifty chartes each. It will be seen that time was consumed in testing.

Objective Tests Used

Coincelive tests A. A. C. - Three objective tests made by the writer covering strictly the caterial intand as noidatempiregre to bolized Maew-mat end of te gold be determined, These tests contained various se of the new type tests such as, true-false, best ner, woodless and solutions. I made them evel from mranying snaver book, In sooring these tests all quesis, except problems, counted as a voint, Problems, since a beingy feet dose to seroce fatof adl .owf beroce en Tie but largely they remained much the same in diffity. A forty-five minute class pariod was used as the sing time for each objective test. It is assumed by the

them standardized tests, expecially is used over or periods of testing, notually measure very few items wit. The is of course in direct variance with objective to serecially constructed for those periods.

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Testing Periods

Date of testing. - Form 1A-1B of the Columbia

Research Bureau Algebra Test and Objective Test A were

given at the beginning of the first ten weeks of experi
mentation and again at the close of the period. Measurement

of the gain or loss was extimated.

Form 2A-2B of the Columbia Research Bureau Algebra Test and Objective Test B were given before the experiment of the second ten-week period began and like the preceding tests given again at the close of that period. Measurement of the gain or loss was deducted.

The results of Form2A-2B at the end of the second ten week period were the initial scores for the beginning of the third ten-week period since the same test was used again. Objective Test C was given at the opening of this period and at the close Form 2A-2B and Objective Test C were given. As in all preceding tests the gains and losses were tabulated.

eardh Bureau Algebra Test and Objective Test A were in at the beginning of the first ten weeks of experication and again at the close of the period. Measurement the main or lose was againsted.

Date of testing. - Fore lA-13 of the Columbia

Form 21-23 of the delimbia Reserve Eprent Algebra and Objective Rest 3 were given before the experiment the second ten-week period began and like the preceding a given again at the close of that period. Hearntenent the gain or lose was deducted.

The results of FormSA-2B at the end of the second week period were the initial scores for the beginning the third ten-week period since the same test was used in. Objective Test C was given at the opening of this icd and at the close Form SA-2B and Objective Test C

sommed in all preceding tests the gains and losses

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CHAPTER V

PRESENTATION AND INTERPRETATION OF TEST DATA

Data Obtained from the Tests

Recording data. - The records of each pupil taking the tests have been carefully recorded. An examination of the table following will reveal that opposite to each pupil whose name has been designated by numbers in each group, is the sum of the gains made from the first two forms of the first standardized test given at the beginning of the first ten-week period. It must be kept in mind that each of these standardized tests had two forms and both were given at the same time and a composite score recorded. This procedure was repeated with the same test at the close of the first ten-week period and the gains of these two were recorded. The informal objective test A was given at the beginning of the first ten-week period and again at the close. The gain was computed from the score made the first time and the score made the second time. Each of the two different groups were under different procedures.

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Table 3. - Scores and gains made by individual pupils during the first ten-week period.

Gro			itat			od	Grou			pervi			
Pupil Num- ber	Colu	mbia arch au bra			or- ec- e	Gain	Pupil Num- ber		nbia arch au bra	Gain	Inf ma]	or- ec-	Gain
1	2	3	4	5	6	7	8	9	10	11	12	CONTRACTOR AND ADDRESS.	14
1	57	60	3	25	27	2	1	44	69	25	33	34	1
2	50	58	8	26	34	8	2	31	35	4	22	16	- 6 ¹ /
3	43	56	13	23	25	2	3	39	64	25	21	25	4
4	32	36	4	20	21	1	4	43	57	14	22	29	7
5	37	70	33	17	21	4	5	46	78	32	29	30	1
6	54	71	17	28	36	8	6	47	77	30	25	28	3
7	38	62	24	31	32	1	7	33	59	26	36	35	- 1
8	27	43	16	18	27	9	8	32	45	13	28	34	6
9	44	56 64	12	23 22	22 30	-1 8	9	47 38	67 67	20	26 24	32 28	6 4
11	39	49	10	33	36	3	11	39	51	12	21	22	1
12	45	60	15	27	32	5	12	32	33	1	20	23	3
13	51	57	6	22	40	18	13	33	42	9	20	20	0
14	28	45	17	16	22	6	14	23	33	10	15	18	3
15	21	38	17	15	22	7	15	36	46	10	26	27	1
16	39	57	18	11	22	11	16	16	29	13	23	20	7
17	23	37	14	16	19	3	17	21	39	18	18	18	0
18	35	57	22	27	22	- 5	18	23	54	31	20	25	5
19	25	36	11	17	24	7	19	16	38	22	20	17	- 3
20	16	18	2	8	11	3	20	12	22	10	10	14	4

^{1/ -} indicates a loss rather than a gain.

Table 5. - Goores and gains adde by individual pupils during the time described.

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						EF				15			
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	1.0					14			16	TI			14
I.			0.0			1.5			BI	P.F		Is	1.5
		EG			o.r								
			3.6			DT.			3.6				
							2 -						
8 -									17				
											2.8		

. At a steel a loss variet than a gain.

It is to be noted that the scores made by each pupil at the beginning of each ten-week period is much smaller on the whole than at the close. These same scores at the beginning of the period in the case of the objective tests are much lower and in a few cases very low but the reader need only keep in mind that these tests covered practically all new and untaught materials. A close examination of this data is revealing.

The procedure followed for the second ten-week period did not change from that of the first ten-week period. The only changes that did occur were in the tests. In this period the Columbia Research Bureau Algebra test 2A-2B and the informal objective test B were used.

In the third ten-week period of experimentation the same standarized test, Bolumbia Research Bureau Algebra test 2A-2B, was used at the beginning and the end. The initial score therefore is the same as the last score obtained by this test in the second ten-week period. The informal objective test C was given at the beginning and at the close of the ten-week period. As in the preceding experimental periods the gains were computed.

Tables 4 and 5 will be found on the following pages.

It is to be noted that the scores ande by each

month at the heginning of each ten-week period is much smaller on the smale than at the close. These same scores at the heginning of the period is the case of the objective the heats are much lower and in a few cases very low but the reader need only keep in that these tests covered that the all new and entaught attended. A close exactostion of this data is revealing.

The procedure followed for the second ten-week period. Deriod did not change from that of the first ten-week period. The only changes that did occur were in the tests. In this period the followhis Research Bureau Algebra test 21-23 and the informal objective test B were used.

In the third ten-week period of experimentation the same standarized test, Solumbia Wassarch Durson Algebra test SA-SB was used at the beginning and the same same, who initial accre therefore is the same as the last ocore obtained by this test in the second ten-week period. The informal objective test C was given at the beginning and at the close objective test C was given at the beginning and at the close objective test C was given at the popular and at the close of the ten-week period. As in the preceding experimental periods the gains were computed.

cables 4 and 5 will be found on the following

. Bagan

Table 4. - Scores and gains made by individual pupils during the second ten-week period.

Pupil Num- per	Res	ebra	it Me Gain	In ma Ob ti	for- jec- ve st	Gain	Group Pupil Num- ber	Col Res Bur	- Recumbia earch eau ebra t		n Ir ma Ot ti	ifor-	Gain
	(1)	(2)		(1)	(2)	~		(1)	(2)		(1)	(2)	-
	2	3	4	5	6	7	8	9	10	11	12	13	14
1	27	44	17	1	7	6	1	26	58	32	6	12	6
2	35	72	37	5	12	7	2	13	31	18	1	- 5	4
3	33	52	19	4	10	6	3	32	53	21	5	11	6
4	19	34	15	5	10	5	4	29	62	33	8	11	3
5	18	48	30	4	12	8	5	26	62	36	6	16	10
6	41	72	31	5	12	7	6	30	48	18	8	7	-1
7	32	55	23	6	11	5	7	17	37	20	10	14	4
8	15	39	24	3	8	5	8	23	27	4	4	9	5
9	20	37	17	2	9	7	9	34	59	25	5	13	8
10	28	41	13	5	11	6	10	27	40	13	12	10	-2
11	24	68	44	6	12	6	11	12	18	6	7	10	3
12	21	47	26	5	11	6	12	15	41	26	2	7	5
13	14	27	13	6	13	7	13	19	43	24	2	7	5
14	20	32	12	2	9	7	14	11	19	8	1	6	5
15	13	29	16	5	3	-2	15	18	42	24	4	8	4
16	16	44	28	6	11	5	16	14	27	13	3	10	7
17	10	50	40	4	6	2	17	16	25	9	3	6	3
18	26	40	14	3	4	1	18	14	34	20	5	11	6
19	16	45	29	4	8	4	19	18	36	18	4	8	4
20	8	19	11	3	4	1	20	12	18	6	2	3	1

Table 4. - Scores and gains made by individual popils during the second ten-meak meriod.

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I-										22			
5							6	11					
8				75								ar	
8	1.3												
2-	10							11		13			
2				19	2.2	12				100			
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26			nr		9.7	1.9						2.0	67
1		15.				08	1	15	8	II	191	16	7-00

Table 5. - Scores and gins made by individual pupils during the third ten-week period.

Gr	oup	I - Su	perv	ised	Met	hod	Gro	up I	- Ur	it M	ethod		=
Pupil Num- ber	Col Res Bur Ala Tes	lumbia search reau gebra	Gain	Inf mal Obj tiv Tes C	or- ec- e	Gain		I Colu		Gain		r- G	ain
	(1)	(2)		(1)	(2)			(1)	(2)		(1)	(2)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	44	44	0	3	8	5	1	58	53	-5	4	8	4
2	72	78	6	3	9	6	2	31	24	-7	1	3	2
3	52	66	14	6	7	1	3	53	53	0	3	8	5
4	34	29	-5	2	14	12	4	62	72	10	4	8	4
5	48	48	0	4	11	7	5	62	72	10	5	12	7
6	72	73	1	2	11	9	6	48	43	-5	7	11	4
7	55	54	-1	6	14	8	7	37	44	7	3	7	4
8	39	38	-1	1	9	8	8	27	28	1	2	4	2
9	37	44	7	3	4	1	9	59	69	10	4	13	9
10	41	51	10	1	6	5	10	40	64	24	5	11	6
11	68	73	5	6	11	5	11	18	24	6	4	10	6
12	47	55	8	4	7	3	12	41	46	5	2	3	1
13	27	38	11	3	7	4	13	43	53	10	2	8	6
14	14	37	23	2	6	4	14	19	31	12	2	5	3
15	29	41	12	2	7	5	15	42	53	11	5	11	6
16	44	53	9	4	2	-2	16	27	29	2	5	13	8
17	50	44	-6	1	12	11	17	25	39	14	4	10	6
18	40	46	6	3	3	0	18	34	30	-4	2	9	7
19	45	46	1	2	7	5	19	36	38	2	4	8	4
20	19	26	7	1	6	5	20	18	17	-1	1	2	1

Table 5. - Scores and gine made by individual popular destag

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Statistical Treatment of Data

The mean gain. - In measuring the three different procedures in each of the ten-week periods, the method of gains is used. This measurement process involves the use of data previously recorded. The mean gain or average gain can be computed by one or two methods. 1/ By the first method the mean gains of the scores made the first time the test was given and again the second time the test was given, were computed. The difference of these mean gains may then be calculated by subtraction. With the second method the individual scores are subtracted and mean gain of the difference obtained. By using both of these methods, one has an excellent check on the correctness of the data. Both methods were used in this study. In computing the mean gain 2/from each test as seen in the three preceding tables, Midesignates the mean gain in raw scores for the second time the test was given and M2 the first time the test was given. This procedure is used so that the gain may be noted. These scores cannot be added to get the total mean gain favoring one procedure or another. This point is clarified by Dr. Billett's discussion regarding the mean gain in his opiginal doctor's dissertation. It points out that the mean

^{1/} Billett, Roy O., Original Doctor's Dissertation, The Administration and Supervision of Homogeneous Grouping, pp. 161.

Z/ Tiegs Ernest W., and Crawford, Claude C., Statistics for Teachers, pp. 49-60, Houghton-Mifflin Company, 1930,

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Otis, Arthur S., Statistical Method in Educational Measurement, pp. 6-11, World Book Company, New York, 1917.

Rugg, Harold O., Statistical Methods Applied to Education, pp. 114-126, Houghton-Mifflin Company, Boston, 1917.

Tiegs, Ernest W., Tests and Measurements for Teachers, pp. 224-226, Houghton-Mifflin Company, Boston, 1931.

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of the difference obtained. By using both of these methods, one has an excellent check on the correctness of the data.

Both methods were used in this study. In computing the mean

may then be calculated by subtraction. With the accond

Undesignates the mean gain in raw scores for the second time the test was given and Mg the first time the test was given. This procedure is used so that the gain may be noted. These scores cannot be added to get the total mean gain favoring one procedure or another. This voint is clarified

by Er. Edilett's discertation. It points out that the mean original doctor's discertation. It points out that the mean original doctor's Discertation, The Administration and Supervision of Homomeous Grouping,

Tiegs Ernest W., and Crawford, Claude C., Statistics for Teachers, up. 49-60, Houghton-Mifflin Company, 1950, Boston.

Otis, Arthur S., Statistical Method in Educational Measure-

ment, pp. 6-11, World Rook Company, New York, Telr.

Rusk, Hareld O., Stakistical Methods Applied to Education
pp. 114-125, Houghton-Mifflin Company, Dosnon, 1917.
Tiegs, Ernest W., Tests and Measurements for Teachers.

gain on certain tests might be very low while ofhers might be high. "Yet from the standpoint of importance, or from the standpoint of difficulty to achieve, they may be of equal value, or indeed the greater may be of lesser value." 1/

It is for this reason that it has been necessary to divide these mean gains by some common unit so that they may be added to give the total effect of one procedure of one group to that of another.

The standard deviation. - That common unit is the standard deviation of the group score taken as a whole and figured for each standardized test and each objective test. For this purpose the following formula was used:

$$V = \sqrt{\frac{\xi fd}{N}} \times \text{size of class interval}$$

The median. - The medians for each of the tests were found. While they do not bear directly upon this study they are consistent with the allied data and are reported in the Appendix of this work. In computing the medians on this test data the formula reported by Tiegs was used. **

As a check against errors in this work the medians were worked according to the technique employed by Douglass. **

4/

^{1/} Billett, Roy O., op. cit., pp. 163.

^{2/} Tiegs, Ernest W., op. cit., pp. 230.

^{3/} Ibid., pp. 225.

Douglass, Harl Roy, Modern High School Teaching, pp. 418-419, Houghton-Mifflin Company, Boston, 1926.

gain on cortain tests sight be very low shile ofhers sight be high. Wet from the examinant of importance, or from the standpoint of importance, or from the standpoint of difficulty to achieve, they may be of equal value, or indeed the greater may be of lesser value." L

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Investmi casto to sais x (A22) 123

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1/ Billett, Moy O., op. cit., pp. 163.
3/ Tiegs, Conest W., op. cit., rp. 230.
3/ Ibis., pp. 285.
4/ Downless, Harl Soy, Modern High School

Downlass, Harl Soy, Modern High School Penching,

Table 6. - The means made on each test for Group I and Group II.

Types	Gr					Means							
of teach-			rst t	en- w	reek	Sec per	ond t	en-	week	Thi per		en-wee	k
ing proce- dures	-		bra		tive	Colum Resea Burea Alge Test	au bra		ctive		arch au bra	Information Object Test	tive
		1	2	1	2	1	2	1	2	1	2	1	2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Reci-	I	38	51.5	21.2	26.2	x	x	x	x	x	x	x	x
tion	II	x	x	x	x	20.3	39	4.9	9.2	x	x	x	x
Super-	I	x	x	x ·	x	x	x	x	x	43.8	49.2	2.95	8.05
vised	II	32.5	50.2	22.4	24.7	x	x	x	x	x	x	x	x
Unit	I	x	x	x	x	21.8	44.7	4.2	9.01	x	x	x	x
	II	x	x	x	x	x	x	x	x	39	44.1	3.45	822

Table 7. - The mean gains made on each test for Group I and Group II.

Types	GHO	Time i M		Mean Gai	-		
teach-	o u p	First Toperiod	en-week	Second to	en-week	Third to	en-week
proce- dures	s p	Research		Columbia Research	Objectiv	Columbia re Researc	
		Bureau Algebra Test	Test	Bureau Algebra Test	Test	Bureau Algebra Test	tive Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	I	13.5	5	x	x	x	x
tion	II	x	x	18.7	4.3	x	x
Super-	I	X.	X.	x	x	5.35	5.1
	II	17.7	2.3	x	x	x	x
Unit	I	x	x	22.9	4.8	x	x
	II	x	x	x	x	5.1	4.7

olesw-d				-119			alee	w -ds	boiz			-dos
Inform Object	done											-330
/aoT												
I.		7777							8	I		
[18]				(8)				(3)	TAX	(1)	TEX	
×				×			2,89	Sals	8.16			-io
30			2.0	0.4		20,5						
20.5	5.03	9.81						. 4				-10
/30							7.18	22.4	50.8	32.5		
20			10.0	8.4	44.7	B.IS						
3.45	1.40					35					II	
bns I	duon	0. 200					enleg		old" .	7.	alda	

.II quon

				512		
0 -d	Tiret Te	Mentelk		n-week		260330-13
			boites			in the later of
g -9			Solumbia Research	Objective		-ostdo.n
						svid
	Algelra Test					deal
(3)	[8]	(4)			(0)	(8)
Ī	18.5	a			×	70
			T. O.	Č a		30
I -3					5.05	5.3
	17.7	2,3				
			22.9	E.4		- 8
					I.a	4.7

The mean gains having been calculated, it was next necessary to find the standard deviations of each of these same test scores. This was done by using the formula already referred to. 1/

Table 8. - The standard deviations of the pupils scores in Group I and Group II.

Types	G				Star	ndard	Devi	ation	S				
teach-	o u		rst to	en- w	reek	Seco	ond to	en- w	reek	Thi: per:	rd ter	n-wee	k
proce- dures	- р s	Column Research Burearch Algel	arch au	Obje	rmal ective	Column Research Bures Algeliant	au bra	Info Obje Test		Column Research Burea Algel Test	arch au bra	Info Obje Test	ctive
		1	2	1	2	1	2	1	2	1	2	1	2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Reci-	1	11.4	12.9	22.	24.5	x	x	x	x	x	x	x	x
tion	II	x	x	x	x	6.6	15.6	.9	3.3	x	x	x	x
Super-	I	x	x	x	x	x	x	x	x	15.	13.4	2.4	3.3
V1504	II	10.4	16.2	6.	6.3	x	x	x	x	x	x	x	x
						4.4			1		1		
Unit	I	x	x	x	x	8.4	13.2	1.8	2.4	x	x	x	x
	II	x	x	· x	x	x	x	x .	x	13.5	16.2	•54	3.0

^{1/} See pp. 38.

Table ". - The standard deviations of the pupils" socres

												1	
	1-week		ridl		-110				w -Its	t tes			
it	Infor		Colum					Legg	0000			g .	
			Fores Algel Tost		JesT		Algel						
8					I			8		8			
I.E.												681	
×	×							84.5	. 28	12.9	A. II	I	
×				8.8	0.	15.6	8.0						
	1.5	18.4	15,		30	×						I	
X								6.3	. 0	16.2	10.4		
20				4.8	8.5	13.2	1.2						

Mean gains in terms of standard deviation. - Having calculated the mean gains and the standard deviations of each test, the mean gains in terms of the standard deviation for these tests was sought. The formula $\frac{1}{2}$ for the procedure was $\frac{1}{2} - \frac{1}{2} - \frac{1}{2} \cdot \frac{$

For this process the standard deviation for the following tests, Columbia Research Bureau Algebra test Form 1A-1B and Form 2A-2B and the informal objective tests A, B, and C, was computed for both groups. A total of all cases in both groups was used.

Table 9. - Standard deviations of the distributions of scores, made by all pupils participating in the study, on the standardized and informal objective examinations used to measure outcomes.

Tests (1)	Standard Deviation (2)	ıs	
Columbia Research Bureau Algebra Test 1A-1B	13.98		
Columbia Research Bureau Algebra Test 2A-2B	7.6		
Informal Objective Test A	6.6	14	
Informal Objective Test B	2.56		
Informal Objective Test C	1.92		

Billett, Roy O., The Administration and Supervision of Homogeneous Grouping, pp. 48-49, Ohio State University Studies, 1932.

^{2/} The score used to compute the standard deviations on the standardized tests were obtained by adding total score on Form 1 of the test to total score on Form 2.

metvel - .noitchweb brabasje to emret mi enisa meell rol notifaives branches and to ented it enter meem and test these tests was sought. The formula & for the procedure was bus saley masm add at somerellib edf own M - M - M - M noitaive. It represented the standard deviation. ollowing tests, Tolumbia Hosserch Bureau Almebra test Porm A-13 and Ford SA-28 and the informal objective tests A. E. nt cases fie to letof A aguara fied tot between asw . O bu oth groups was used. To anoity distributions of the distributions of scores, made by all pupils participating in the study, on the standardized and informal objective examinations used to measure outcomes. -13,98 7.6 ASAS test sudoul 0.0 2,56 S0.I Billett, Roy O., The Administration and Supervision of Acmogeneous Grounding, mp. 4 - 49, Onlo State University

The mean gain in terms of standard deviation is calculated for each test, standardized and objective, by first
attaining the difference of the mean gains of the first time
the test was given and of the second time the test was given
and dividing this result by the standard deviation of the
test. Example: Using Table 6 page 38 to get the mean gains
of the tests and Table 8 page 39 to find the standard deviation, one has for the mean gain in terms of standard deviation:

This process is repeated for each of the tests.

Table 10 shows the gains in terms of standard deviation for each form.

Table 10. - The mean gain of the tests in terms of standard deviations.

Types	Gr		Gains in t		-	-	
teach-	1	First	en-week	Second to	en-week	Third ter	n-week
ing proce- dure	u p s	Columbia Research Bureau Algebra Test	Informal Objective Test	Columbia Research Bureau Algebra Test	Informal Objec- tive Test	Columbia Research Bureau Algebra Test	Informal Objec- tive Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	I	•9656	.7575	x	x	x	x
tion	II	x	x	2.460	1.679	x	x
Super-	I	x	x	x	x	.7030	2.650
	II	1.859	•3484	x	x	x	x
Unit	I	x	x	3.019	1.875	x	x
	II	x	x	x	x	.6710	2.440

The mean goin in terms of standard deviation is calulated for each test, standardized and objective, by first
thaining the difference of the mean gains of the first time
he test was given and of the second time the test was given
ad dividing this result by the standard deviation of the
eat. Example: Using Table 6 page 50 to find the standard devia-

38.5 - 38 - 9856 38.08

This process is repeated for each of the tests.

able 10 shows the gains in terms of standard deviation for ach form.

ton, one has for the mean gain in terms of standard devis-

Toble 10. - The mean gain of the tests in terms of

**************************************	enoidaived	hrebnet	erms of S	derne in t			
ilaew-i	Third ten	Neew-He		Mean-ue	* HEEFLA	T O	-doss
Information - object	aktivitoo i Hosasah Durasu Alsabra Jasi	Information of the contract of	Columbia Sesarch Bureau Algebra	Ismrotel Object Tast	Research Bureau Algebra	2 6 50	ng roce-
(8)	(4)	(8)	(8)	(4)	(8)	JEZ	(1)
x	22			avar.	.9856		-iss
	×	1.679	2,460	x			mei
2,650	,7030	30		32	× ·	I.	7590
*		30		.3434	1,859		
- 2		1.875	8.019		25	I	
024.8	.6710	30	x	×			

Using the standard deviation in this study. - The use of the standard deviation technique as employed in this experiment is briefly stated. The mean gain of each test is tabulated, then the standard deviation of those tests calculated. Then the mean gains in terms of the standard deviation, using the standard deviation derived by treating the total cases in the experiment, is derived by dividing this into the mean gain for the test. This gives the mean gains in terms of standard deviation for that particular test.

The second step is to compute the mean gains in terms of standard deviations between the means of the different groups using the same test with - in the same ten-week period. 1/ Once this technique is employed the means in terms of the standard deviations may then be added to determine a greater gain or loss by any of the procedures.

each of these tests served as an excellent check in determining the mean gains in terms of standard deviations of two different procedures since the difference in the mean gain of the two procedures would equal the mean gain in terms of standard deviation or M, of one test minus M2 of the other test. For example: The mean gain in terms of standard deviation of Columbia Research Bureau Algebra test 1A-1B is .9656 for the recitation method the first ten-week period with Group I; of 1A-1B for the same test in the supervised plan with Group II the mean gain in terms of standard deviations was 1.859.

Like technique is used by Dr. Roy O. Billett in his doctor's dissertation, The Administration and Supervision of Homogeneous Grouping, original paper, pp 164-165.

use of the standard deviation technique as amployed in this at the of the standard deviation technique as amployed in this experiment is briefly stated. The mean gain of each test is tabulated, then the standard deviation of those tests ealer-lated. Then the mean gains in terms of the chandard deviation derived by treating the tion, using the standard deviation derived by treating the

into the mean gain for the test. This gives the mean gains in terms of standard deviation for that corticular test.

The second step is to compute the mean gains in

terms of the standard deviations between the means of the differont groups using the same test with - in the ease ten-week pariod. If the this technique is employed the means in terms of the standard deviations may then be added to detersine a greater gain or loss by any of the procedures.

The mean grine in terms of standard deviations for each of these tests served as an excellent check in determining the mean grine in terms of standard deviations of the difference in the mean grin of the two procedures would equal the mean gain in terms of the other example: The mean gain in terms of the other test, for example: The mean gain in terms of standard deviation of Columbia Research Bureau Algebra test la-13 is

vistion of Columbia Research Bureau Algebra test 1A-1B is . 9656 for the recitation method the first ten-week period with Group I: of 1A-1B for the same test in the supervised plan with Group II the mean gain in terms of standard deviations was 1.859.

After the transfer of the Administration and Supervision of

The difference between these is .8941. When the mean gain in terms of standard deviation was computed using the mean gains for each group under different methods the answers checked. Thus, M, represents the mean gain of the supervised plan with Group I for the first ten-week period and M 2 the mean gain for the traditional with Group II for the same period. The standard deviation for the two groups of that same test was 13.98. Then 26 - 13.5 .8941

In determining the difference in the mean gains in terms of standard deviations for the different procedures the same formula was used as before.

M, the mean gain in raw scores of the plan having the highest gain in each case and M 2 the mean gain in Raw scores of the plan of the lowest gain. This was true for both objective and standardized tests. The resulting quotients are each labelled according to the plan receiving the favoring score.

The difference between these is .8941. Then the mean gain in terms of standard deviation was computed using the mean gains for each group under different methods the answers chucked.

Thus, H. represents the mean gain of the supervised plan mith droup I for the first ten-weak partial and M. the mean gain for the traditional with droup II for the same period. The standard deviation for the two groups of that came test was standard deviation for the two groups of that came test was standard deviation for the two groups of that came test was standard deviation for the two groups of that came test was standard deviation for the two groups of that came test was

terms of standard deviations for the different procedures

M the mean gain in rew scores of the plan having the highest gain in see and M the hean gain in new the highest gain in see and the plan of the lowest gain. This was true for both objective and standardized tests. The resulting quotients are each labelled according to the plan receiving the fevering score.

Table 11. - Difference of the mean gains in terms of standard deviation of the groups within each ten-week period.

Types	G	First	ten-week	Second period	ten-weel	Third ter	n-week
teach-	o u	Columbia Research	Informal Objec-	Columbi Researc	a Informa h Objec-	al Columbia Research	Informal Objec-
ing proce-	p	Bureau	tive	Bureau	tive	Bureau	tive
dures	S	Algebra	Test	Algebra Test	Test	Algebra Test	Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ylolds		1/	volue w	leh the		stror smil	1 2012
Reci-	I	=/	.409	x	x	x	x
tion	Iŧ	x	x			x	x
		II =					
Super-	I	x	x	x	x	•0328	•2083
VIDEU	II	.8941	in steal	x	x	x	×
Unit	I	x	x	•559	•1935	x	x
van ob	II	x	x	x	x	he ware out	

The figures in the preceding table reveal a difference favoring one or another of the three procedures involved in the study.

It was an endeavor of the experiment to show whether or not these figures are <u>real</u>, in that they actually favor one or another of the groups from the result of being equated and taught differently. 2/ This can be accomplished through the application of the probable error formula. 3/ Through the probable error formula only the maximum and minimum values can

^{1/} Measurement compared but the difference in gain favored the other equated group.

^{2/} Billett, Roy O., op. cit., pp. 165.

Walker, Helen M., The Standard Error of a Difference, Journal of Educational Psychology, Volume XX, pp. 57-58.

7	o amo	ns in ter	e meen gai opa within	nee of the	- Differer	ble 11. sand der sandard der riod.	ta	
20	sew-c	Third ter	den-week	Second	Magw-Hes	Barra .	0	
Cemal Ce	Info	Columbia Research	Informal -osido	Columbia	Informal Objec-	Golumbia Renearch		-
	tive		svij		tive Test		8	-
-	785	Test	787	Test	(A)	Test	TEN	

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-neffit a leaver eldst guibeceng edt mi sarugit adT beviount assubecord sends and to rentons to eno univovel so the study. sught differently. 2 This can be accomplished through the onlication of the probable error formula. 2 Through the

. guern bejsupe medio Hillett, Hoy C., op. cit., pp. 165.

Walker, Helen M., The Standard Error of a Difference, Jour-

be determinded. Because of the limited time for this study it was not possible to calculate the coefficient of correlation of the tests and since the minimum probable error formula uses this, it was impossible to consider it.

The formula used in this computation is known as the short formula for computing the probable error of the difference of two means in terms of standard deviations. It yields the maximum value which the probable error could have. 1

The maximum probable error formula is:

P. E.
$$\frac{M_1 - M_2}{7} = \frac{.6745}{\sigma_7} \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}$$

Once the probable error is found, it is possible to calculate the critical ratio. In this study the critical ratio was obtained by dividing the difference of the mean gains of the two plans in each period by the probable error. In using this formula the standard deviations of each test was used as of and of North represented the cases involved which in this instance was twenty each. Of is the standard deviation derived from using all forty cases employed in the study.

^{1/} Walker, Helen M., op. ctt

^{2/} See Table 8.

e determinded. Recause of the limited time for this study it as not possible to calculate the coefficient of correlation for the tests and since the minimum probable error formula uses

The formula used in this computation is known as he short formula for computing the probable error of the ifference of two means in terms of standard deviations. It islds the maximum value which the probable error could have.

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Once the probable error is found, it is possible to aloulate the critical ratio. In this study the critical ratio as obtained by dividing the difference of the mean gains of he two plans in each period by the probable error. In using his formula the standard deviations of each test was used as not of the cases involved which in this natance was twenty each. Or is the standard deviation derived row using all forty cases employed in the study.

Table 12. - Probable error obtained from the differences in the mean gains of the groups in terms of standard deviations.

Types	G	First te	n-week	Second to		Third ten-	week
teach- ing proce- dures	o u p s	Columbia Research Bureau Algebra Test	Informal Objective Test		Informal		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	I	1/	1940	x	x	×	x
tion	II	x	x	?	-	x	x
Super-	I	x	x	x	x	•3968	.0611
	II	.1600	-	x	x	x	x
	FEX	CATTER BY	LOD WON O	br-Coed 4	n no love	chal-obta	12 19 10
Unit	I	x	x	.2112	.0373	x	x
	II	x	x	x	x		

The critical ratio is a procedure used for the purpose of determining the probability of like results again occurring should the experiment be repeated. Table 13 shows tha number of chances out of a 1000 that certain critical ratios may be due to chance error.

^{1/} Measurement compared but the difference in gain favored the other equated group.

Billett, Roy O., op. cit., pp. 198.

Table 12. - Probable error obtained from the differences in the mean gains of the groups in terms of standard deviations.

-	week.	ned bride	n-week	Second to	n-week	First te		800
	Torord -beido evit	Reserrch	Imrormi Objec-	dolumens Research Sureau	Lamidini Objec- ovit	Golumbia Research Bureau		-nos
	test.	Algebra				Algebra		-900:
	TAIL	(77)	[3]	[8]	(6)			(1)
			×		.1940	18		-iss
	×				22	×		
	.0611	8398	×	x				rper-
	20		×		*******	.1600	TI	
			.0373	2112.				321

The critical ratio is a procedure used for the purose of determining the probability of like results again courring should the experiment be repeated. Table 13 shows

ha number of chances out of a 1000 that certain critical

Measurement compared but the difference in gain favored the other equated group.

Table 13. - Number of chances out of 1000 that a given critical ratio may be due to chance error or improper sampling.

Critical Ratio	Chances ou due to cha	t of 100 that nce error or (2)	ratio in improper	dicated i	s <u>1</u> /
0.0 0.5 1.0 1.5 2.0 2.5	To libra lass	500 368 250 155 89 46	Informal Objective Cest	Described Research Re	Infor- mal Object- cire Test
3.0 3.5 4.0 4.5	1 33	22 9 4 1			

Thus, it will be noted that a critical ratio such as 3.4 for example, which was obtained on an informal objective test in this study, has but about 9 chances out of a 1000 of being a chance error. An examination of the table shows like figures for other critical ratios obtained.

Table 14, which follows, is for the difference in mean gains in terms of standard deviations as the tests of different procedures were used. The purpose was to throw light on the value of the different methods as they progressed in each ten-week period.

Table 13. - Number of obserces out of 1000 that a fiven oritical ratio may be due to chance error or improper sampling.

Changes out of 100 that ratio indicated is 1/	Isolding Satio
500 368 260 250 250 46 46 46 46 46 46 46 46 46 46 46 46 46	0.0 0.5 1.0 0.5 2.5 2.5 0.5 8.5 8.6 4.6

Thus, it will be noted that a critical ratio such as evitocide (such an informal objective of for example, which was obtained on an informal objective at in this study, has but about 9 chances out of a 1000 of sing a chance error. An examination of the table shows like inverse for other critical ratios obtained.

Table 14, which follows, is for the difference in sen gaine in terms of standard deviations as the tests of ifferent procedures were used. The purpose was to throw light the value of the different methods as they progressed in the value of the different methods as they progressed in the value of the different methods as they progressed in

Table 14. - Critical ratio obtained from dividing the difference in mean gains in terms of standard deviations by the probable error.

Types	G	First	ten-week	Second period	ten-week	Third ter	n-week
teach-	0		Informal		Informal	Columbia	
ing proce-	u	Research Bureau	Objec- tive	Research Bureau	Objec- tive	Research Bureau	mal Objec-
dures	ps	Algebra Test	Test	Algebra Test		Algebra Test	tive
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	I	1/	2.108	x	x	x	x
ta- tion	II	x	x	Target 1	10.1	x	x
01011			348-44	partota		^	A
Super-	I	x	x	x	x	.0806	3.400
vised	II	5.580	at In the	x	x	x	x
	100		-				
Unit	I	X	x	2.640	5.235	x	x
1-2-00	II	x	x	x	x		-

^{1/} Measurement compared but the difference in gain favored the other equated group.

Table 14. - Critical ratio obtained from dividing the difference in mean gains in terms of standard deviations by the probable error.

Noow-	Third ten-	ien-week	Second t	Masw-meak	First	0	RedA
-20701	Columbia				Columbia		-dose
Lar - 591.dC				-00,000	Research	, #1 , #1	ng rege-
			Algebra	Test			ures
(8)	(4)	(8)	(5)	(4)	Test (3)		(1)
					A		
				2,108	manual .		-109
	x		patricina			II	not
5.400	8000.						- Tegu
				According to	088.8		
	72	5.255	2,640	x		I	tim
						TT	

Outcomes of this study. - The findings of the study are interesting. Since each of the ten-week periods amounted to individual units of experiments, the deductions of these findings are to be first considerd. 1/ The data is that that has been derived from calculating the difference of the mean gains in terms of the standard deviation.

An examination of Graph 1 shows the trend in each of these periods. When the difference of the standardized tests and the informal objective test is considered, the difference of the mean gains favors the supervised plan by .4851 for the first ten-week period.

It is to be noted that during the second ten-week period the difference in mean gains in terms of the standard deviation for both standardized and informal objective test favors the unit plan. This total figue is .7525. In the third ten-week period when the difference in the mean gains in terms of standard deviation was computed between the supervised procedure and the unit, it was found that the difference favored the supervised plan by a total of .2411. It is evident therefore that the supervised plan taken as a whole shows greater gain but such a statement should only be considered in the light of the findings for each testing period.

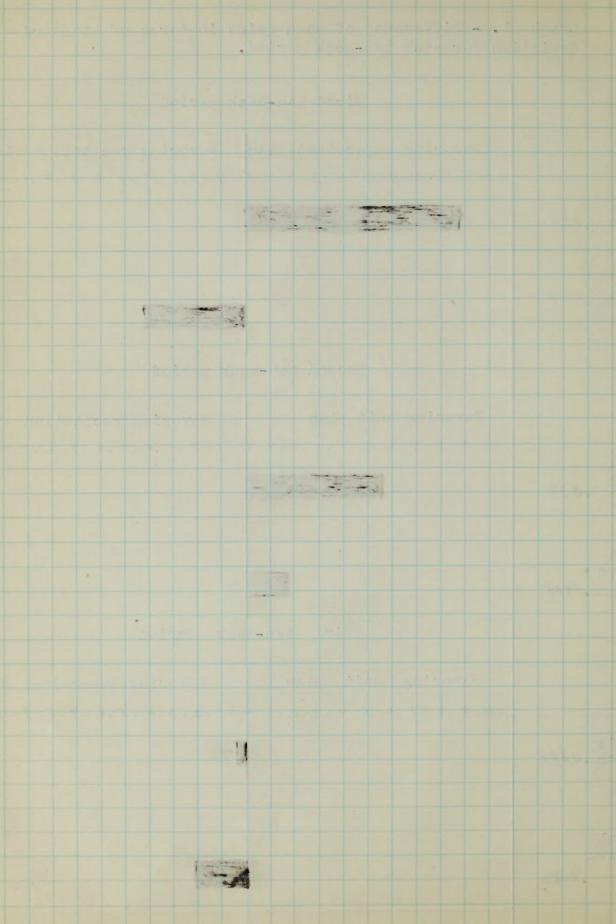
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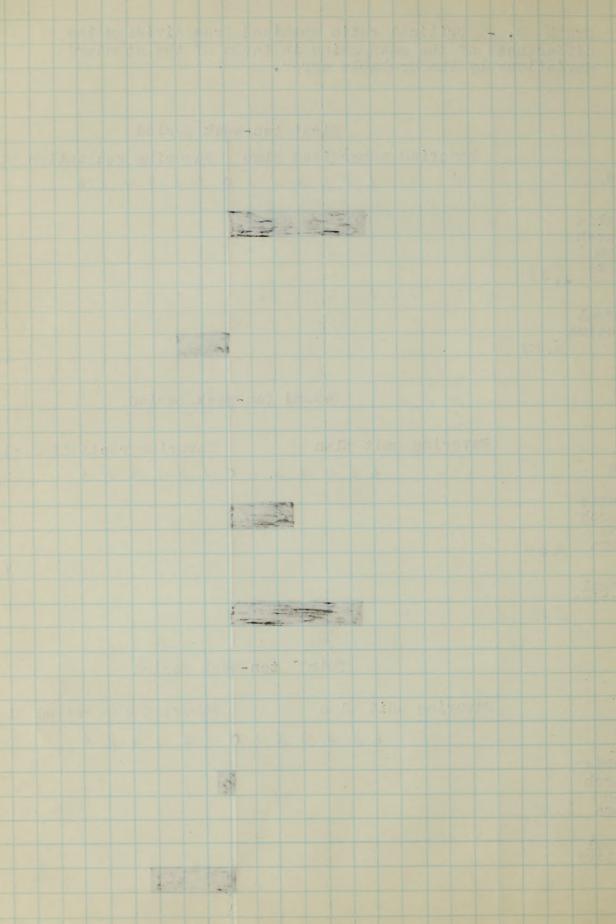
Graph 1. - Difference of mean gains in terms of standard deviation for each ten-week period.

		First ten-	-week period
		Favoring supervised pl	lan Favoring recitation plan
Tests		.10.9.8.7.6.5.4.3.2.	10.1.2.3.4.5.6.7.8.9.10
Columbia Research Bureau Algebra Test	.894		
Informal Objective Test	.409		
		Second ter	n-week period
		Favoring unit plan	Favoring recitation plan
Tests		.10.9.8.7.6.5.4.3.2.	10.1.2.3.4.5.6.7.8.9.10
Columbia Research Bureau Algebra Test	.559		
Informal Objective Test	./935		
		Third te	n-week period
		Favoring unit plan	Favoring supervised plan
Tests		.10.9.8.7.6.5.4.3.2.	1 0 . / . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9 . 10
Columbia Research Bureau	.0328		
Algebra Test			
Informal Objectiv	е		
Tests	. 2083		



Graph 2. - Critical ratio obtained from dividing the differences of the mean gains in terms of the standard deviations by the probable error.

		ale mani ad
		n-week period
m - 4 -		an Favoring recitation plan
Tests	65432	, 0 1 2 3 4 5 6
Columbia		
Research Bureau		
Algebra 5.58		
Test		
Informal		
Objective Test 2./0%		
2.		
	Second T	en-week period
	Favoring unit plan	Favoring recitation plan
Tests	65432	10123456
Columbia		
Research Bureau		
Algebra 2/4		
1696		
Informal Objective		
Test 5, 23		
	Third to	eh-week period
	Favoring unit plan	Favoring supervised plan
Tests	65432	10123456
Columbia		
Research Bureau		
Algebra .08 Test		
Informal 3.40 Objective		
m I		
Test		



To be sure that our figures would likely run true if the experiment were repeated, these critical ratios are shown. The data for this is taken from Table 14. These critical ratios when compared to the chances in a 1000 for chance error or improper sampling are seen to be creditable conclusions.

Conclusions drawn from the experiments. - It is possible, therefore, to conclude that for the first ten-week period the data showed a favorable difference in mean gains in terms of the standard deviation for the supervised plan, in the second ten-week period a favorable difference is noted for the unit procedure, and in the third ten-week procedure the difference in the gains is favorable to the supervised plan.

Taken as a whole, considering each period as individual units of study, the supervised plan seems to show a greater favorable difference in mean gains in terms of standard deviations.

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Taken as a whole, considering each period as inlividuel units of study, the supervised plan seems to show a greater favorable difference in mean gains in terms of standard deviations.

CHAPTER VI

COMPARISON OF THE UPPER HALF OF THE GROUPS.

AND OF THE LOWER HALF OF THE GROUPS.

Studying the Effects of the Teaching Procedures upon the Upper Half of the Groups and upon the Lower Half of the Groups.

The purpose of this part of the study. - Since pupils differ widely in ability and since methods and teaching techniques are necessary to meet this variation, an interesting part of this study was the objective to learn the effect of the three plans on the upper half of the pupils as compared to the lower half in each of the groups.

Division of groups. - The pupils were first divided evenly in Groups I and Group II on the basis of intelligence quotient. On the data sheets labelled Tables 3, 4, and 5 pages 32, 34, 35, one may find the scores and gains of each pupil on each test. The pupils designated by numbers 1-10 are the "upper half" of the group and those listed as numbers 11-20 are the "lower half" of the group.

Statistical treatment. - As in the preceding part of this paper the mean gains were used as methods of measurement. The data was treated with the same statistical technique. Table 16 shows the mean made in each test by Group I and for Group II for the "upper half" and the "lower half" of the pupils.

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of this paper the mean gains were used as methods of measurement. The data was treated with the same statistical technique. Table 16 shows the mean made in each test by Group I and for Group II for the "upper half" and the "lower half" of the number.

Table 16. - The means of the test scores for both groups of the upper half and the lower half.

Types	G					Means							
of	r	_		n-weel	2	Second		-weel				-week	
teach	- 0	peri	the Person Name of Street,			period	THE RESERVE AND PERSONS ASSESSED.		or Department of the last	peri	-		-
ing	u			Inform		Colum						Inform	
proce	_			Object	tive	Resear							rive
dures	S	Burea		Test		Bureau		est		Bure		Test	
		Algel				Algeb				Alge			
		1	2	1	2	1	2]	2	1	2	1	2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	10)	(11)	(12)	(13)	(14)
	7	,						1					
Reci-	Iu	42.9	57.6	23.3	27.5	x	x	x	x	x	x	x	x
ta-	-u	1000		20.0	~ 1 .0	22	3.	-		-	4.	25	3%
tion	I	32.2	45.4	19.2	25.0	x	x	x	x	x	x	x	x
02011	-1						- 17	170					
	IIu	x	x	x	x	25.7	47.7	6.5	10.8	x	x	X	x
	u								-				
	II	x	X	x	x	14.9	30.3	3.3	7.6	x	x	x	x
	-				-							,	
Super		x	X	x	x	x	x	x	x	49.4	52.5	3.1	9.3
vised	I ₁	X	x	x	x	x	x	x	x	38.3	45.9	2.8	6.8
	IIu	40.	61.8	26.6	29.1	x	x	x	x	x	x	x	X
							25	25	22	21.	25	afte.	20.
	II ₁	25.3	1 38.	7 18.3	3 20.4	x	x	x	X	x	x	X	X
									1				
Unit	In	x	x	x	x	26.8	49.4	4.0	10.	2 x	x	x	x
	I	x	x	x	x	16.8			8.		x	x	x
	_T	25	12	3.		20.0	70.1	7.07		- A		Α.	^
	IIu	77	77	W.	75	N.P.	95	52"	~	ATY	7 50	9 7 6	0 0 6
	III	X	X	X	X	X	X	X	X	430	3.3 3	2 3 . 8	7 7
	T									1			

The Roman num eral represents the group in each case. The subscript uis used to designate "upper half" and 1 - "lower half" of the group.

					MELLINE		vw-1		
Magn-	net bain't		50W-111	Di Bu	1000	Moss-nod date			190
Informal Objective Test	Co.bumbia	I am		deta.	Column Hares	a vita	rear rear	dons	
		B					I.		- The same
- VE - C 7 - C C	TEFT TIES		101	7		(8)	(5)		
X X	T. Z.					2, 75			
· * *	× 20					0,84			e 20
* ×		2.01	3.3 9	47.	7.85	×	20		
		8.7	8.8	.08	24.9				70
3.2 9.3	9.4 58.5	1) 30	75						
8.3 0.2	0.8 45.9			30					
	x x					1,08			
						1.05	n		1.68
		2.01	0.4	4,84	8,85		30		
		I.B		1.00	e of				
2.8.8.8.8	86.8 36.				¥				

man ut eval represents the group in each case. The ubsoript ed to designate "ne malf" and I - "lower half" of the

Table 17. - The mean gains of the test scores for both groups of the upper half and the lower half.

The man of	G		Mo	an Gains	1/		
Types	r	First to		Second to	/	Third te	n-week
teach-	0	period		period		period.	1,001
ing	u		Informal		Informal		Infor-
proce-	p	Research		Research		Researc	
dure	8	Bureau	tive	Bureau	tive	Bureau	0
		Algebra	Test	Algebra	Test	Algebra	tive
-A11-	701	Test	(4)	Test	761	Test	Test
91)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	Iu	14.7	4.2	x	x	x	x
ta- tion	I	13.2	5.8	X	x	x	x
proce-	IIu	х	x	22.0	4.3	x	x
	II ₁	x	x	15.4	4.3	x	x
7/11			(4)	15)	(6)		101
Super-	Iu	x	x	x ,	x	3.1	6.2
vised	Il	x	x	x	x	7.6	4.0
	IIu	21.8	2.5	x	x	x	x
	II ₁	13.6	2.1	x	x	x	x
Unit	Iu	x	x	22.6	6.2	x	x
	Iı	x	x	23.3	3.7	x	x
	IIu	x	x	x	x	14.5	5.0
	II1	x	x	x	x	5.7	4.8

Table 17. - The mean gains of the test scores for both groups of the upper half and the lower half.

		-1					
. 89	0		Me	anteb or	17		
1	1 1	et jerie	m-wesk	Second te	Moow-III		Nosw-s
-Mo.	. 0	period		period			
		sidewloo	Informal				
-80	q	Research	Objec-	Research			
8	8 -		svid	Bureau			Objec-
, ,						Algebra	
	785	Test (3)	7.5		753	test (7)	Test
- in a	13/		(4)	(5)	(3)		(8)
-1		14.7	4.2	π			x
		13.2	5.8		x		x
44		·x	x	0.88	4.3	30	20
	III	x	×	15.4	4.3		×
-70	nI	X		30	20	3.1	6.2
	II				x	7,6	0.4
	uII	8.18	8,5				20
		13,6	2.1			×	x
3	In		x	0,88	8.0	×	×
	II	X	X	23.3	3.7		X
		×	×		30	14.5	0.0
	FII	x	×	x	×	5.7	4.8

It will be recalled that in order to be able to get the probable error for the results when the difference of the mean gains in terms of standard deviations was computed that it was necessary to have the standard deviation of the scores of each test. These were computed and are tabulated.

Table 18. - The standard deviation of pupils' scores in groups one and two for the upper half and the lower half.

Types	G		Standar	d Deviat:	ions		
of	r		ten-week	Second	ten-week	Third ter	n-week
teach	- 0	perio		period		period	
ing	u	_	a Informal		Informal	Columbia	
proce		Researc	•	Research		Research	
dure	S	Bureau	tive	Bureau	tive	Bureau	Objec-
	7.	Algebra	Test	Algebra	Test	Algebra	tive
	701	Test	741	Test	761	Test	Test
-(T)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	Iu	8.97	3.27	x	x	x	x
ta- tion	I ₁	10.27	7.23	x	x	x	X
	IIu	x	x	6.06	3.21	x	X
	II1	x	x	.732	2.01	x	x
Super-	Iu	x	x	x	x	12.48	1.98
vised	I ₁	x	x	x	x	12.36	2.27
			+338				
	IIu	4.71	4.50	x	X	x	x
	II ₁	9.24	4.05	x	x	x	x
Unit	Iu	x	x	6.66	1.37	x	x
	I ₁	x	x	5.88	4.50	x	x
	IIu	x	x	x	x	11.94	3.90
	II ₁	x	x	x	x	9.27	7.23

It will be recalled that in order to be able to the probable error for the results when the difference the mean gains in terms of standard deviations was contend that it was necessary to have the standard deviation the scores of each test. These were computed and are bulated.

Table 18. - The standard deviation of purils' scores in groups one and two for the upper half and the lower half.

-			-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
Magw-s	Third ter	den-week	Second t	Meek - net			
	botrog				boired		-nio
Infor		Informal					
		-00jec-	Research				-80
Objec.	Bureau				Bureau		
	Algebra		Algebra				
					Test		
(8)	(7)	(6)	(8)			(S)	-
				3.27	46.8		
	72			7.23	10.27		
		3,21	80.8	. ×			
X		10.8	987.				
		20,000					
1.98	12.48						-7
78.8	12.36	X				II	5
						T	
		×		O.EO	4.71	FII	
		20		4.05	9.24	III	
				× ×			
		1.87	00.0				
30		4.50	88.8	32		II	
06.8	11.94						
7.25	9.27				7		

Following the same technique as in the first part of this study, the mean gains in terms of standard deviations was calculated.

Table 19. - The mean gains of the tests in terms of standard deviations for the upper half and for the lower half of each group.

Types	G	Mean First to	Gains in	Second te		rd Deviat	
teach.		period	T	period	T-0-	period	
ing proce-	u	Research	Informal	Columbia		100000000000000000000000000000000000000	
dure	- p	Bureau	tive	Research Bureau	tive	Research Bureau	Objec-
aule	3	Algebra	Test	Algebra	Test	Algebra	tive
		Test	1000	Test	1000	Test	Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	Iu	1.05	.637	x	x	x	x
ta-	Iı	.944	.879	х	x	x	X
tion .	7.7			0.00	7.00	-	-
	IIu	X	X	2.89	1.68	x	X
1102	II1	^	^	2.03	T.00	X	x
	77				2343		
Super-	Iu	x	x	x	x	.408	3.22
vised	I	x	x	x	x	1.00	2.08
	IIu	1.56	.379	х	x	x	x
	II1	.973	•318	x	x	x	x
	77			4		7	76
		,00			Z		
Unit	Iu	x	x	2.97	2.42	x	x
Bult	Il	x	x	3.065	1.45	x	x
	IIu	х	x	x	X	1.90	2.47
	II1	x	x	x	x	.75	2.5

Following the same technique as in the first part this study, the mean gains in terms of standard deviations calculated.

Table 19. - The mean gains of the tests in terms of atandard deviations for the upper half and for the lower half of each group.

			NAME AND ADDRESS OF TAXABLE PARTY.	And the state of the last of t			
88		Mean	Gains in	To amust		rd Derlati	No.
100	7	ef feria	Meek-m	Second te	n-week	ansi baini	310 979-
-do	0 .			boirer		holined	
						Columbia	
-80	d.		-sate			Research	Lam
0					tive	Bureau	-00:00
					Test		ovis
	- was agricultural	jesT		Test		Test	JaeT
	(8)	(8)	(4)	(5)		(2)	(3)
		-0 -					
1		1.05					X
	II	.944	648.	×			X
45				28.89	1.68	x	
	III		×		88.1		X
	Tor			00.00	00.1		
TE .		×		32	20	804,	3.22
bs	II					1.00	80.8
		1.56	.379				X
3-	LII	.973	.318				
-							
	-						
6	to I	30	X	2,97		X	
	TI	×		3,065	1.45	32	
		100				00 5	- TVA - C
	LII	X		×		1.80	2.67
				X		87.	2.5

Following the calculation of the mean gains in terms of standard deviations of each of the tests, the next consideration was that of getting the difference of the mean gains in terms of standard deviations of the upper half and of the lower half of each group. This difference would show a gain for one of the procedures in each case.

Table 19. - Difference of the mean gains in terms of standard deviations of the groups within each ten-week period.

Marin o a	0	Dinak A	le	becase	ton wools	mlaind to	o wools
Types	G First ten-week r period			Second ten- week Third ten-w period period			n-week
teach-			Informal		Informal	Columbia	Infor-
ing		Research		Research		Research	
proce-	FR		tive	Bureau	tive Test	Bureau Algebra	Objec- tive
dure		Algebra Test	Test	Algebra Test	1656	Test	Test
-(1)	(2)	(3)	(4)	(5)	(6)	$-\frac{1}{7}$	(8)
		1/					
Reci-	<u>I</u> u		.2545	x	x	X	x
ta- tion	Iĩ		•5606	X	X	X	x
01011	IIu	x	x			x	x
	III	x	x		.2343	x	x
-	-					-	
Super-	Iu	x	x	x	x		.7812
vised	Iı	x	x	x	x	.250	• 102.0
				1-01			
	IIu			X	x	x	x
1	II1	.03		x	x	X	X
Unit	I		x	.08	.7421	x	x
	I	1 x	x	1.04		x	x
	IIu	x	x	x	x	1.50	
Street and	III	x	x	x	x	JESHS 55 6	.4115
Wile Wi			1000		11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
					-		

Indicates that this test was used in getting the difference of the mean gains in terms of standard deviation but that the difference favored the other plan which in this case was the supervised plan.

Following the calculation of the mean gains in react of standard deviations of each of the tests, the next naideration was that of getting the difference of the mean ins in terms of standard deviations of the upper half and the lower half of each group. This difference would show gain for one of the procedures in each case.

Table 19. - Difference of the mean gains in terms of standard deviations of the groups within each ten-week period.

-		contract the second second			-	-	
205W-1		ten-week		Mensell - Mensel	Birst te		
-	period		bottes		bolzeg nidmmfor	T	
-molal			Columbia	Informal			-Mi
Lam	Research		Research	-00100			
Objec-	Bureau		Bureau	svij			-01
	Algebra		Algebra		Algebra		
	Test (7)	(8)	Test (5)	- Talen	(8)	-785	-
(8)	11	101	161	[6]	The state of the s		
					17		
X				2545		H	-
30			X	9099.		Er	
				X	32	7.7	
		.2343				III	
		0.200.				Tra	
SIBT.					30	UI	-118
42010	A 200			36	×		
*******	085.						
		x			.5078		
	X			-	80.	III	

		, TARL	80.		X U		
			1.04		X T	I	
			1				
	1.50		>0		75	HII	
ALLS.		30					
	GREATER						

indicates that this test was used in getting the difference of the mean gains in terms of standard deviction but that the standard deviction and the same at the course of the same at the

Table 20. - Probable error obtained from the differences in the mean gains of the groups in terms of standard deviations.

Types	Gr	First to	en-week	Second to	en-week	Third ter	n-week
teach-	1			Columbia Informal			
ing	u	Research		Research		Research	
proce-		Bureau	tive	Bureau	tive	Bureau	Objec-
dure	5	Algebra	Test	Algebra	Test	Algebra	tive
a dia c	_	Test	ast	Test		Test	Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci-	Iu		.0283	x	x	x	x
ta-	I	-	.8453	x	x	X	x
	IIu	x	x		great Barridging	x	x
	II ₁	х	x		1.29	x	x
Super-	I _u	x x	x x	x	x x	4.82	.485
	IIu	.1542		x	x	x	x
	II ₁	.6627	COLUMN TO STATE OF THE STATE OF	x	x	x	x
Unit	Iu	x	x	2.84	3.09	x	x
Unit	Iı	X	x	1.63		x	x
	IIu	x	x	x	x	4.84	
	II1	x	X	X	x	-	.840

This data on the probable error was used in computing the critical ratio as explained previously. 1

Table 20. - Probable error obtained from the differences in the mean gains of the groups in terms of standard deviations.

THOW -	red build	an-week	Second 5	3/8 317-178	et teriff	0
	bolued		boited		boisso	T
-TOTEL	sidmu feb	Informal			Columbia	
	Research	Ocjec-	Research	Objec-	Recestain	
-osido		tive			Bureau	a
tive					Algebra	
					Jest	
(8)	(7)		(3)	(A)	(3)	(8)
				8880.		OI
				.8453		il.
		1.29				
.485					70	
	\$8.4		X			II
					.1542	DII
			X	-	tsaa.	
		3,09	48.5			
		-	1,65			II
	4.84				×	
048.	-					III

This date on the probable error was used in computing

Table 21. - Critical ratio obtained from dividing the difference of the mean gains in terms of standard deviations by the probable error. 1/

Types	Gr	First	ten- week	Second period	ten-week	Third te	n-week
teach- ing proce- dure	o u p s		Informal Objective Test		Informal Objective Test		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reci- ta- tion	Iu I1		8.99	X X	x x	x x	x
02011	II _u	x x	x		.1810	x x	x
unit	2030	Lire of t	eaching	ay a gonald	or delicate	argin.	
Super-	Iu	x	x	x	x		1.61
Vised	Il	x	x	X	X	.520	
	II _u II ₁	3.29		x	x x	x x	x
	30		A Committee	and the second			
Unit	Iu II	x x	x x	.0278	.0403	x x	x x
week y	II _u II ₁	x x	x x	x x	x x	•310	•490

Table 21. - Oritical ratio obtained from dividing the difference of the mean gains in terms of standard deviations by the probable error.

and the same of th							
1007-1	Third ten	ten-week	Becond	Meaw -net	Jeniu	0	
	period		portiod		boined		
-Tolol			sideuloo	Intornal	dolumbia		-11
				Objec-	Research		
-osldo	Mesmill	tive		evit			-8
tife		Test	FidegIA	JaeT.	Algebra		
feet			feet				
(8)		(8)	(8)	(4)	(8)		
						-	
X				66.8	any and a second	In	-
X	X	X	K	688.			
30					x	UII	
7		O.CEI.	-	×		III	
1.61	ACCRECATE OF					UI	-1
all and the same of	.520				36	II	
70	-				8.29		
	×					LII	
X			X		.044		
7.		.0403	8730.	3%		uI.	
			.636			DI.	
		-					
	0.53.0					III	
084			×			III	
- A							

Outcomes of the study. - During the first ten-week period the difference of the mean gains in terms of standard deviation of the upper half equated pupils of Group I and Group II show a favorable difference in gain of .2533 1/ for the supervised procedure. In the second ten-week period the difference was favorable to the unit plan of teaching by .321. For the upper half pupils in the third ten-week period a difference of .72 was noted for the unit plan. So then as far as the upper half of the pupils in the equated groups were concerned the difference in the mean gains of the test in terms of standard deviation was favorable to the unit procedure of teaching by a considerable margin.

As to the <u>lower half</u> during the first ten-week period the difference of the mean gains in terms of standard deviation show .531 in favor of the recitation technique. In the second ten-week period this difference is favorable to the unit plan by .805. While the third tenweek period has a favorable difference of .16 for the unit plan.

^{1/} This difference is obtained by getting the difference of the findings of the standardized and informal objective tests since their measurement is varied.

Outcomes of the study. - During the first ten-week od the difference of the mean gains in terms of standard ation of the upper half equated pupils of Group I and I and I show a favorable difference in gain of .2533 1/2 the supervised procedure. In the second ten-week period difference was favorable to the unit plan of teaching od a difference of .72 was noted for the unit plan. So as far as the upper half of the pupils in the equated as far as the upper half of the pupils in the equated test in terms of standard deviation was favorable to the procedure of teaching by a considerable mangin.

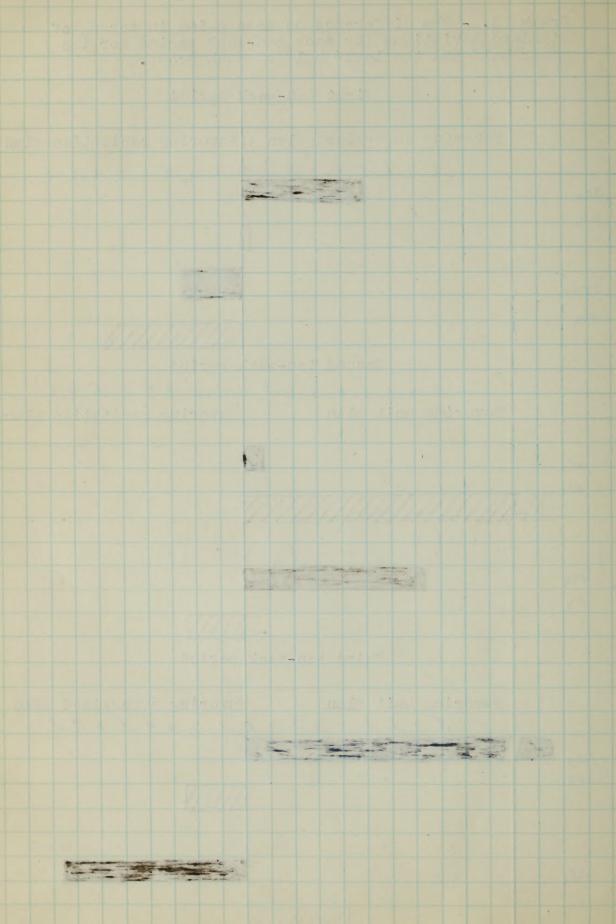
As to the lower half during the first ten-week

As to the lower half during the first ten-week od the difference of the mean gains in terms of standeviation show .531 in favor of the recitation techne. In the second ten-week period this difference is rable to the unit plan by .805. While the third tenperiod has a favorable difference of .16 for the unit

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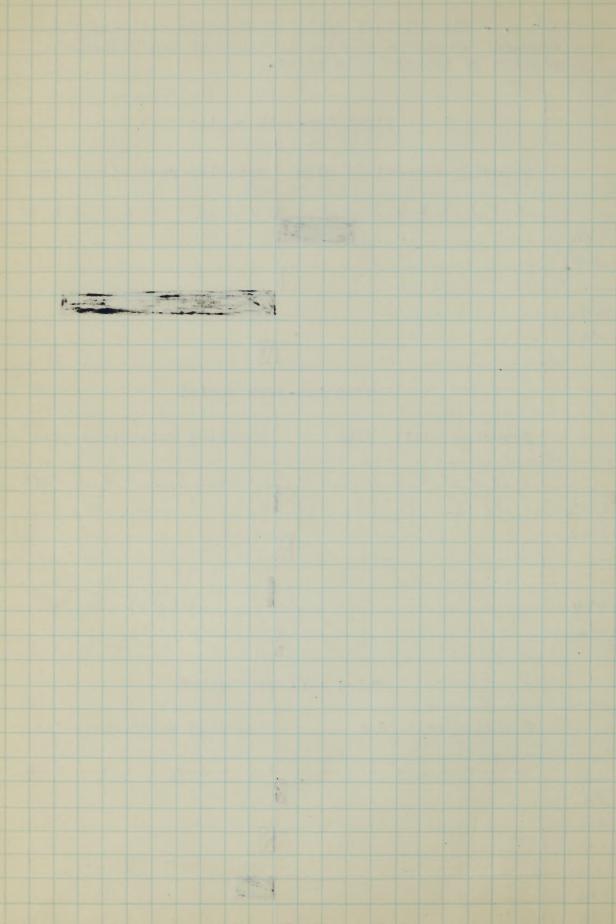
Graph 3. - The difference os mean gains in terms of standard deviations for each ten-week period for the upper half and the lower half of each group.

		First ten-week	k period
		Favoring supervised plan	Favoring recitation plan
Tests			
		.8.7.6.3.4.3.2.1	0.1.2.3.4.5.6.7.8
Dagaanah	ou		
Bureau	34		
Algebra Test			Y .
Informal			
Objective. 2	544		
Test	764		WITHING THE STREET
,			VIIIIIII
		Second ten-wee	
			0.1.2.3.4.5.6.7.8
		Favoring unit plan	Favoring recitation plan
Tests			
Columbia	.084		
	. 044		
Bureau Algebra	7///		
Test			
Informal	.744		
Objective	. 234		
Test			TITTI TITTI
			777774
		Third ten-week	period
		Favoring unit plan	Favoring supervised plan
Tests			0 .1 .2 3 .4 .5 .6 .7 .8
	1.54		
Columbia	1251		
Research Bureau			
Algebra Test			
Informal			
Objective Tests	·784		
10000	.414	MILLION TO THE PARTY OF THE PAR	



Graph 4. - The critical ratio obtained by dividing the difference of the mean gains in terms of the standard deviation by the probable error.

		dev	iation by the probable erro	r.
9			First ten-w	eek period
			W-1199 95111	eek period
			Favoring supervised plan	Favoring recitation plan
	Tests			
			10987654321	012345678910
	Columbia	2		
	Research Bureau	3.294		
	Algebra	044.		
	Algebra Test	,0444		
	Informal	900		
	Objective	8.994		
	Test	.6634		
	1000			N
			Second ten-	week period
_				
			Favoring unit plan	Favoring recitation plan
_	Tests			
	10000		10 9 8 7 6 5 4 3 2 1	9 1 2 3 4 5 6 7 8 9 10
	Columbia			
	Research	. 62784		
		, 636 4		
	Algebra	, , , ,		
	Test			
	1620			
	Informal			
	Objective	.044		
	Test	. 18,		
	1050			
			Third ten-	week period
			Favoring unit plan	Favoring supervised plan
	Tests			
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0	Columbia	31		
	Research	, 3/4		
	Bureau	, 524		77
	Algebra			N
	Tests			
	Informal	1.64		
	Objective			
	Test	.492		The second secon



From an examination of the Table of critical ratios it will be noted that the differences in mean gains in terms of standard deviations have a lower total critical ratio computation for the unit procedure in the upper half group and hence the chances for the same measurement if repeated are less. This is interesting since a total computation of the mean gains in terms of standard deviation for the upper half favors the supervised plan but when the difference is considered for each ten-week period this is decreased.

Considering this upper half group then for the whole of the testing periods in the light of the difference of the mean gains in terms of standard deviations the favor seems to lay in the direction of the unit procedure with the supervised technique following closely, the latter having more favorable critical ratios. The lower half of the group by a much less margin favors the unit method with the recitation method following closely.

It needs to be stated that these measurements, especially for this section of the experiment, are based on a very limited mumber of cases and are therefore less reliable as to predictive value.

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11 be noted that the differences in mean gains in terms

12 andard deviations have a lower total critical ratio com
23 ion for the unit procedure in the upper half group and

25 the chances for the same measurement if repeated are

26 this is interesting since a total computation of the

27 gains in terms of standard deviation for the upper half

28 the supervised plan but when the difference is consider
29 ach ten-week period this is decreased.

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SUMMARY OF THE EXPERIMENT.

The experiment has certain shortcomings that cannot be overlooked. The experience of the writer in dealing
with such an undertaking is a limiting factor in itself
since he was necessarily learning through experience the
techniques of such a study.

The small number of pupils tested and in each equated group makes for less reliability in the measurement, particularly is that true in the case of the upper half and the lower half of the groups.

With these groups there was not a wide range of intelligence quotients and hence the difference between them is small. A heterogeneous group or one with a greater range would have proved more valuable. This part of the study is open for further investigation. As it was the upper half of the groups in differences of mean gains in terms of standard deviations showed a favorable trend to the unit method. While the lower half of the groups showed a slight trend that way with the recitation method closely following.

With the whole group the difference of the mean gains in terms of standard deviations favored the super-vised procedures and such a result when considered in the manner in which our plans were used is a reasonable out-come. It is most interesting to note that the unit proce-

SUMMARY OF THE EXPERIMENT.

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dure follows and that the recitation method is last in comparison.

The study to those involved in the experiment has clearly indicated the great possibilities of the supervised procedure and the unit method in teaching of ninth-grade algebra in comparison to the recitation procedure.

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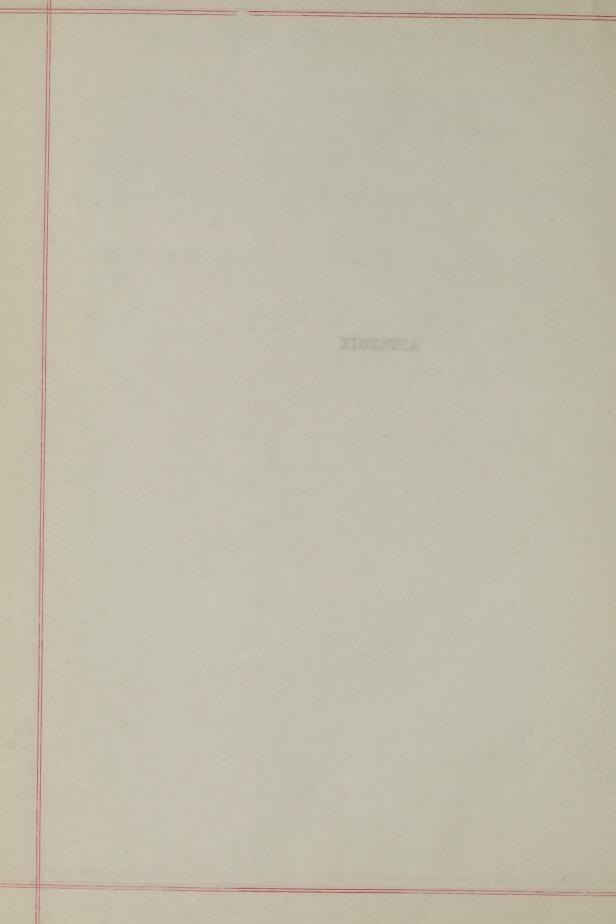
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medical or the own of these tests may study Table 22. These

Takie 22. - A composite table showing the mediane for each

SEP.										
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test			pole							
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Disgn. Bruset W., Tests and Measurements for Teachers, pp. 22 - 22 - 22 Respiton-Mifflin Company, Reston, 1931.



Computation of the medians. - Those interested in the medians of the sum of these tests may study Table 22. These medians were computed according to the Tiegs method. \(\frac{1}{2}\) As a check agains error they were also computed according to the method advocated by Douglass. \(\frac{2}{2}\)

Table 22. - A composite table showing the medians for each test in both groups.

Types	G					Media	ns							
of teach-	r		irst t	en-we	ek	Second ten-week Third ten-week period								
ing	u	u Columbia Informa				Columbia Infor			nal Co	lum	bia	Infor		
proce- dure	-						Research Obje Bureau Test		tive I	rea		Objective Test		
		Algebra			2	Algebra Algebra					ra 2 1 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	2 (8)	(9)	$\frac{2}{(10)(1)}$	1)	$(\tilde{1}2)$	$(\frac{1}{13})$	(14)	
Reci-	I	39	57	21.5	24	x	X	X	X	X	X	x	x	
tion	II	x	x	x	x	18.5	39	5.1	9.8	x	x	x	x	
		55.5	35.5	70.0						,	- 7		1	
Super- vised	I	x	x	x	x	x	x	x	x	45	46.5	3.3	8.6	
VISCU	II	34	48.5	21.5	24.5	x	x	x	x	x	x	x	x	
		-						149.	1 - E 3				-	
Unit	I	x	x	x	x	21	44	4.1	10.2	x	x	x	x	
	II	x	x	x	x	x	x	x	x	39	44	4.0	9.5	

^{1/} Tiegs, Ernest W., Tests and Measurements for Teachers, pp. 224-227, Houghton-Mifflin Company, Boston, 1931.

^{2/} Douglass, Harl Roy, Modern Methods in High School Teaching, pp. 418-419, Houghton-Mifflin Company, Boston, 1926

s of the sum of these tests may study lable 22. There a vere computed according to the liegs method. If as a spains error they ware also computed according to the alvocated by Douglass. 2/

le 23. - A composite table showing the asdiens for each t in both groups.

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	I	. 8			I.		YEV		1		
(11)	(13)				(8)			(8)		(3)	(8)T
×	x			X B.0	i.		18.5		2.58	2.2	30
8.6						. *			70	*	×
			X						22.5	G	24
				10.1	I. 1	-ša	IS			30	x
1.0	0.0										18

Houghton-Wifflin Townsure in Sich Content, po. 224-Houghton-Wifflin Townsur, Boston, 1981. Lase, Herl Roy, Modern Methods in Sich Johnst Denching.

Table 23. - A composite table showing the medians for each test in the upper half and the lower half of each group.

Trines	G					Medi	ans						
Types	r	Fir	st to	en-we	-week Second ten-week Third te						ten-	week	
teach-	0	per				period period							
ing	u	Colum		Infor	mal	Colum	bia	Inform	nal	Colu	mbia	Infor	mal
proce-	p	Resea	rch	Objec	tive	Resea		Object	ive :	Rese	arch		etive
dures	S	Burea		rest		Burea		Test		Bure		Test	
		Algeb	ra			Algeb	ra			Algebra			
		Test				Test				Test			
-			2	1	2	1	2	1	2	1	2	1	2
(1)	(2)	(3)(4)	(5)	(6)	(7)	(8)	(9) (]	0) (11)	(12)	(13)	(14)
					*.		-					-	
Peci-	Iu	43.5	60	24	28.5	x	x	X	X	X	x	x	x
Reci-	I	34	59	17	21.	x	X	x	x	X	x	x	x
tion						Or.	-7	C . R	77.6	-			-
	IIu	X	X	X	X	27	51	1	11.5	X	X	X	X
	II1	X	X	X	X	15.5	30	3.0	8.0	X	X	X	X
Super-	Iu	x	x	x	x	x	x	x	x	46	5.0	3.7	9.2
vised	-												
	Il	X	X	X	X	X	X	X	X	41	45	3	7.5
	II	40	65	26	30.2	x	x	x	x	x	x	X	x
	II1	23	38.5	19.	6 21	X	X	x	x	x	x	x	x
													1
						- "		4.5					
Unit	Iu	x	X	X	X	28.5	46	4.8	1	8 x	x	X	X
	Il	X	X	X.	X	16	43	5	9	X	X	X	x
	IIu	x	x	x	x	x	x	x	x	51	52.5	4.6	8:3
	III	x	x	X	x	x	X	x	x	33	35	3	9.2

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0.00											

A sample.

UNIT I

Equations of the First Degree in one Unknown.

Assignment I

Ref. Betz - Algebra for Today

- 1. Read carefully pp. 233-235
- 2. Study each illustrative example on pp.235
- 3. Maximum requirement Solve examples 1-28 pp. 236
- 4. Minimum requirement Solve examples 1-20 pp. 236

Assignment II

Ref. Betz - Algebra for Today

- 1. Study the illustrative form on pp. 237
- 2. Maximum requirement Do problems 1-25 pp. 237-238
- 3. Minimum requirement Do problems 1, 3, 5, 7, 9, and 11-25 inclusive pp. 237-238

Assignment III

Ref. Betz - Algebra for Today

- 1. The illustrative example on pp. 239 is important for study
- 2. Maximum requirement Solve examples 1-10 and the odd numbers from 11-33 pp. 239-240
- 3. Minimum requirement Solve the odd numbers from 1-33 pp. 239-240

Assignment IV

Ref. Betz - Algebra for Today

- 1. The paragraph number 121 and the illustrative forms on pp. 240-241 must be studied with great care in order to solve the next assignment
- 2. Maximum requirement examples 1-29 pp. 242-243 Minimum requirement - examples 1-25 pp. 242-243

Assignment V Re

Ref. Betz - Algebra for Today

- 1. Read paragraph 122 with care. Study the illustrative forms 1 and 2 on pp 244
- 2. Maximum requirement Do problems 1-32 pp. 244-245
- 3. Minimum requirement Do problems 1-27 pp. 244

I TIM

Equations of the First Degree in one Unknown.

Ref. Bets - Algebra for Today

T DESCRIPTION

1. Read carefully pp. 233-235

2. Study cach illustrative example on pp. 235

3. Merimum requirement - Solve examples 1-28 pp. 236

4. Minimum requirement - Solve examples 1-20 po. 236

gracent II Hef. Bets - Algebra for Today

1. Study the illustrative form on pp. 237

2. Maximum requirement - Do problems 1-25 pp. 237-238

3. Minimum requirement - Do problems 1, 3, 5, 7, 9, and

11-25 inclusive pp. 237-238

gnment III Ref. Betz - Algebra for Today

1. The illustrative example on pp. 239 is important for study

2. Maximum requirement - Solve examples 1-10 and the odd numbers from 11-33 pp. 239-240

3. Minimum requirement - Solve the odd numbers from 1-33

gmment IV Ref. Betz - Algebra for Today

1. The paragraph number 121 and the illustrative forms on pp. 240-241 must be studied with great care in order to solve the next assignment

2. Maximum requirement - examples 1-29 pp. 242-243

35 Minimum requirement - examples 1-25 pp. 242-243

grament V Ref. Retz - Algebra for Today

1. Read paragraph 122 with care. Study the illustrative

2. Maximum requirement - Do problems 1-32 pp. 244-245

3. Minimum requirement - Do problems 1-27 pp. 244

Assignment VI

ref. Betz - Algebra for Today

1. Same requirement for all - Solve problems 33-45 pp. 245

Assignment VII

Ref. Betz - Algebra for Today

Percentage Problems

1. Maximum requirement - examples 1-17 pp. 246-248

2. Minimum requirement - examples 1-12 pp. 246-248

Assignment VIII Ref. Betz - Algebra for Today

Motion Problems

1. Guide your work by the illustrative procedure on pp. 248-249

2. Maximum requirement - problems 1-15 pp. 250-251

3. Minimum requirement - problems 1-12 pp. 250-251

Assignment IX Ref. Betz - Algebra for Today

Mixture Problems

1. Follow the illustrative example on pp. 252

2. Maximum requirement - Solve examples 1-14 pp. 252-254

3. Minimum requirement - Solve examples 1,3, 6, 7, 10, 14 pp. 252-254

Assignment X Ref. Betz - Algebra for Today

1. Maximum requirement - problems 1-24 pp. 254-256

2. Minimum requirement - problems 1-20 pp. 254-256

Assignment XI Ref. Betz - Algebra for Today

1. Review this whole unit of work with care. Ask questions about any problems or procedures that you are not sure of.

Assignment XII Ref. Betz - Algebra for Today

1. Test on unit

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gnment VI

1. Saze requirement for all - Solve problems 33-45 pp. 245

gnment VII Ref. Betz - Algebra for Today

Percentage Problems

1. Maximum requirement - examples 1-17 pp. 246-248

2. Minimum requirement - examples 1-17 pp. 246-248

2. Minimum requirement - examples 1-15 pp. 246-248
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grment VIII Ref. Bets - Algebra for Today Motion Problems
1. Guide your work by the illustrative procedure on pp. 248-249

2. Maximum requirement - problems 1-15 pp. 250-251

ment IX Ref. Bets - Algebra for Today

fixture Problems

1. Follow the illustrative example on pp. 252 2. Maximum requirement - Solve examples 1-14 pp. 252-254

3. Minimum requirement - Solve examples 1,3, 6, 7, 10, 14

mment X Hef. Betz - Algebra for Today

1. Maximum requirement - problems 1-24 To. 254-255

2. Minimum requirement - problems 1-20 pp. 254-256

1. Review this whole unit of work with care. Ask queetions about any problems or procedures that you are

Nets - Algebra for Today

not sure of.

gament XII Hef. Detz - Algebra for Today

1. Test on unit

A sample.

OBJECTIVE TEST C

Date School Teacher Part I Fractional Equations Solve each equation. Write the answer after the same number as the example on the dotted line on the right side of the paper. 2. $\frac{r+5}{2} - \frac{2r-5}{8} = \frac{2r}{3}$ 3. $\frac{r-8}{2r} = \frac{r+8}{r} - \frac{3}{4}$ 3. $4. \quad \frac{n+1}{d} = \frac{1}{2}$ 5. $\frac{x}{b} + \frac{x}{a} = a + b$ Find x 6. $\frac{x}{4d} + \frac{x}{d} = 1$ Find x 7. Solve the formula: $T = W + \frac{Wa}{G}$ for a 8. Simplify: $\begin{array}{r}
a+b\\
\hline
a-b\\
\hline
a+b
\end{array}$ 9. $3x + 1 + \frac{2}{x}$ 10. $\frac{a-b}{x} + \frac{x^2y}{a}$

ple.	
	OBJECTIVE
I	Part
	Fractional
	equation. Write the

 $I = \frac{x}{6} + \frac{x}{6}$

er efter the same number n the right side of the

	OBJECTIV	TE TEST C	
Nam	ie	Date	
Sch	0001	Teacher	• • • • • • •
	Part II		
Sol	ve each problem. Use the backs k. Write the answer in the spa	side of this sheet for ace at the end of the	r your problem.
1.	If an airplane consumed 40 ga how much gas will be consumed (proportion)	als of gas in going 3' in a trip of 3200 mi	70 miles, iles?
		1	
2.	If a clerk earns \$40 a week, varies directly as the number If w = 10, find i. If i =	of weeks (w) he work	CS.
		2	••••••
3.	Suppose that y varies inverse x = 20, y = 5. Find y, when x	ly as x and that when =50. (inverse varia	nation)
		3	•••••
4.	Find the missing number (x) i proportions:	n each of the followi	.ng
	a) $\frac{5}{7} = \frac{6}{x}$ b) $6x$:	4c ≈ 3r ; 5s 4	•••••
5.	The annual premium on a \$2500 \$70. At the same rate, what w policy for \$6000? (solve by	ould be the premium o	y was n a
		5	• • • • • •

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II tasq
each problem. Hee the backside of this sheet for your Write the answer in the space at the end of the groblem.
on sirulane consumed 40 gals of gas in going 370 miles; we much gas will be consumed in a trip of 5200 miles?
s eleck serns \$40 a week, show that his income (1) wies directly as the number of weeks (w) he works. w 10, find i. If i \$280, find w. (variation)
prose that y varies inversely as x and that when 20, y 5. Find y, when x 50. (inverse variation)
nd the missing number (x) in each of the following opertions:
e annual premium on a \$2500 life insurance policy was 0. At the same rate, what would be the premium on a licy for \$6000? (solve by proportion)

OBJECTIVE TEST C	
Name Date	
School Teacher	,
Part III	
Square Root and Radicals	
Bullett, New Yor Was Administration and Super-	
Draw a circle around the correct answer:	
1. $5\sqrt{3} + 2\sqrt{3} = 7\sqrt{6}$, $14\sqrt{3}$, $7\sqrt{3}$ 1	
2. $3\sqrt{2} + \sqrt{8} = 12$, $6\sqrt{2}$, $\sqrt{48}$ 2	•
3. $2\sqrt{3} + \sqrt{27} = 2\sqrt{30}$, $\sqrt{33}$, $5\sqrt{3}$ 3	
4. $20 - \sqrt{\frac{1}{5}} = \frac{9}{5}\sqrt{5}$, $10\sqrt{5}$, $\frac{1}{5}\sqrt{5}$ 4	•
5. $2\sqrt{3} = 9$ x = 4 x = $6\frac{3}{4}$ x = 28 5	
of the Bulative Effective of Two Dequences in Super-	
Drugue, 1927,	
Part IV	
Equations of the Second Degree	
Solve. Write the answers in the answer column on the right side of the paper.	
1. 5x ² =100	
2. $3x^2 - 13x = 10$ 2	
3. $x^2 + 12x + 36 = 49$ 3	
4. $2x^2 + 5x - 12 = 0$ 4	
5. $4x^2 - 8nx + n^2 = 0$ 5	
Muchillan Company, Ber York, 1923.	

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		Part II		
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			x 4	6 8
		Part :		
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egree	the Second De	t to anoid		
an on the right	answer colu	rs in the	the answe	. Write to
				5x 100
			c = 10	3x - 13
3,,,,,,,,,,			-36 = 4	xSI x
			12 - 0	2x 2 .5x -
			0 = n =	4x 8nx
The late of the la				
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